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SURFACE-DUCT SONAR MEASUREMENTS (SUDS I - 1972) OCEANOGRAPHIC M--ETC(U)
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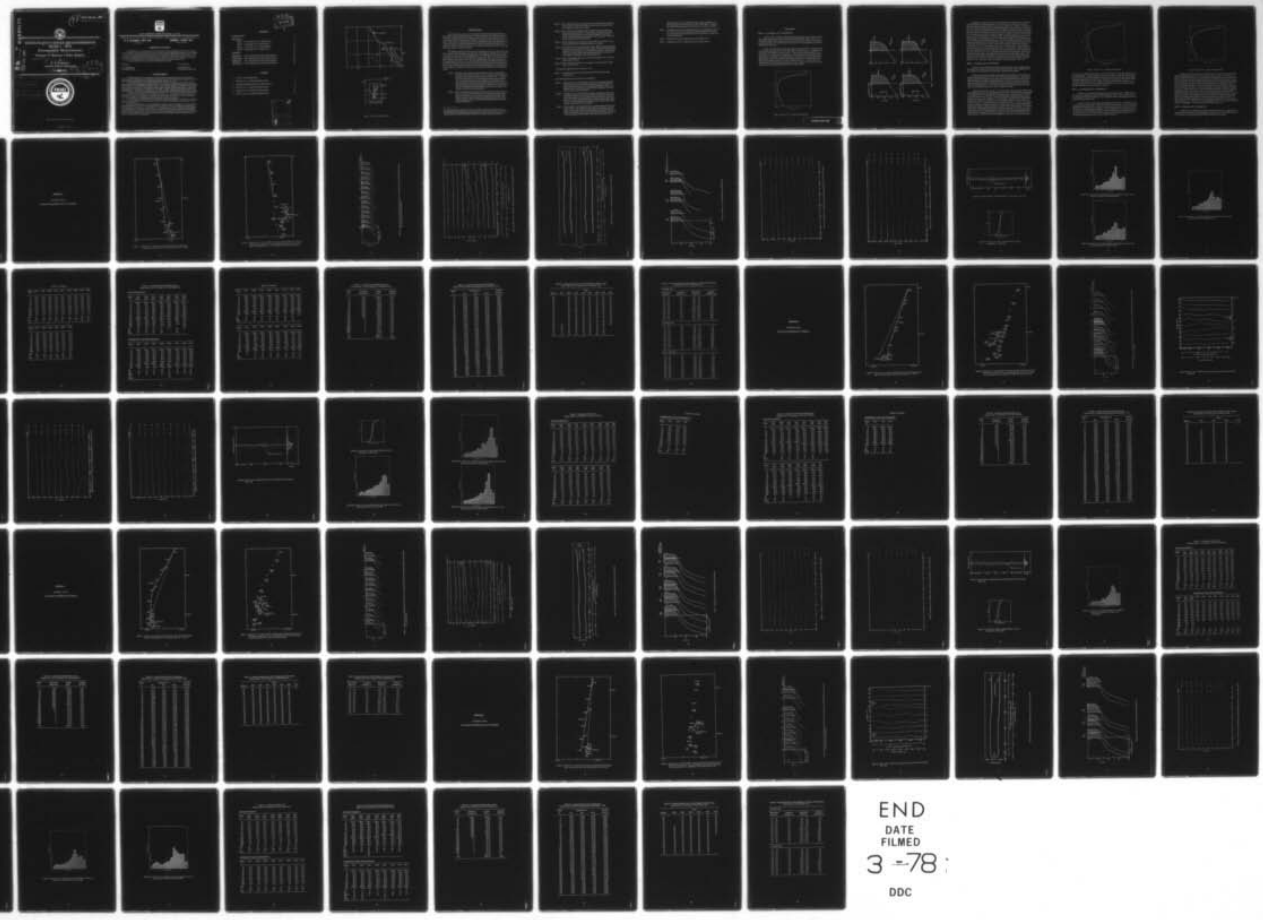

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SURFACE-DUCT SONAR MEASUREMENTS (SUDS I - 1972)

Oceanographic Measurements

Volume V: Station 4 Data Report

by

(10) E. R. Anderson

Undersea Sciences Department

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Technical Director

ADMINISTRATIVE STATEMENT

During February 1972 the Naval Undersea Center conducted a series of 18 propagation loss experiments in three deep-water areas off the coast of California. These experiments are known as the SURface Duct Sonar Measurements (SUDS I – 1972). This work was originally supported by the then Naval Ships Systems Command, Sonar Technology Division, PMS-302-4 and partly supported by the Office of Naval Research, code 102-OSC. The preparation of this report began in April 1973 under the sponsorship of the Naval Sea Systems Command, code 06H1-4, problem SF 52-552-602, task 19344. This report covers work from March 1971 to January 1976 and was approved for publication in March 1976.

Technical reviewers for this report were M. A. Pedersen and P. G. Hansen.

Released by

H. E. MORRIS, Head
Ocean Sciences Group

Under authority of

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ACKNOWLEDGMENTS

The SUDS I program was a coordinated and cooperative effort involving personnel from the Undersea Sciences Department and the Undersea Surveillance Department. Also participating in the oceanographic measurement program were personnel from the Lockheed Ocean Laboratory (Lockheed Missiles and Space Co., Inc.).

The Principal Investigator for the SUDS experiments was J. Cummins. P. G. Hansen and K. W. Nelson were the Senior Scientists for the oceanographic measurements program. D. P. Hamm was the Principal Investigator for the Lockheed Ocean Laboratory. The Lockheed Ocean Laboratory, with L. P. Coates as Program Manager, constructed the Teletherm buoy system, operated the system at sea, and provided the initial reduction of the data. The following assisted in a consulting and planning capacity: E. R. Anderson, P. A. Barakos, O. S. Lee, and W. F. Potter. Assisting in the preliminary data reduction and analysis was J. L. Thompson, an exchange scientists from Royal Australian Navy Research Laboratory, Sidney, Australia.

H. P. Bucker was the Scientist-in-Charge aboard the *DeSteiguer*, D. E. Good, the Scientist-in-Charge aboard the *Lee*, and P. A. Hanson, the Scientist-in-Charge aboard the *Cape*. Assisting with the oceanographic measurements at sea were: A. E. Diamond, H. L. Haskall, C. T. Smallenberger, and W. M. Woods. The assistance of the officers and men of the *DeSteiguer*, *Lee*, and *Cape* in making the oceanographic measurements program a success is acknowledged.

C. L. Barker and C. D. Curtis calibrated the Teletherm buoy sensors, K. W. Nelson, S. L. Speidel, and G. L. Crutcher assisted in the data reduction and computer aspects of the work, and O. S. Lee supervised the spectral analysis of the Wave-rider buoy measurements.

Additional acknowledgments are: Pacific Missile Range, Geophysics Division, Point Mugu, CA, which furnished the Datawell Waverider buoy system; Fleet Numerical Weather Central, Monterey, CA, which furnished the expendable bathy-thermograph probes; Fleet Weather Facility, San Diego, CA, which arranged for air-dropped expendable bathythermographs in the SUDS I areas prior to the ships moving from station 2 to station 3; the Naval Oceanographic Office, Pacific Support Group, San Diego, CA, which provided personnel to make environmental measurements and assistance aboard the *DeSteiguer*; and the Naval Electronics Laboratory Center, Communications Facilities Support Branch, which provided the shore-based portions of the ship-to-shore communications.

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FIGURES

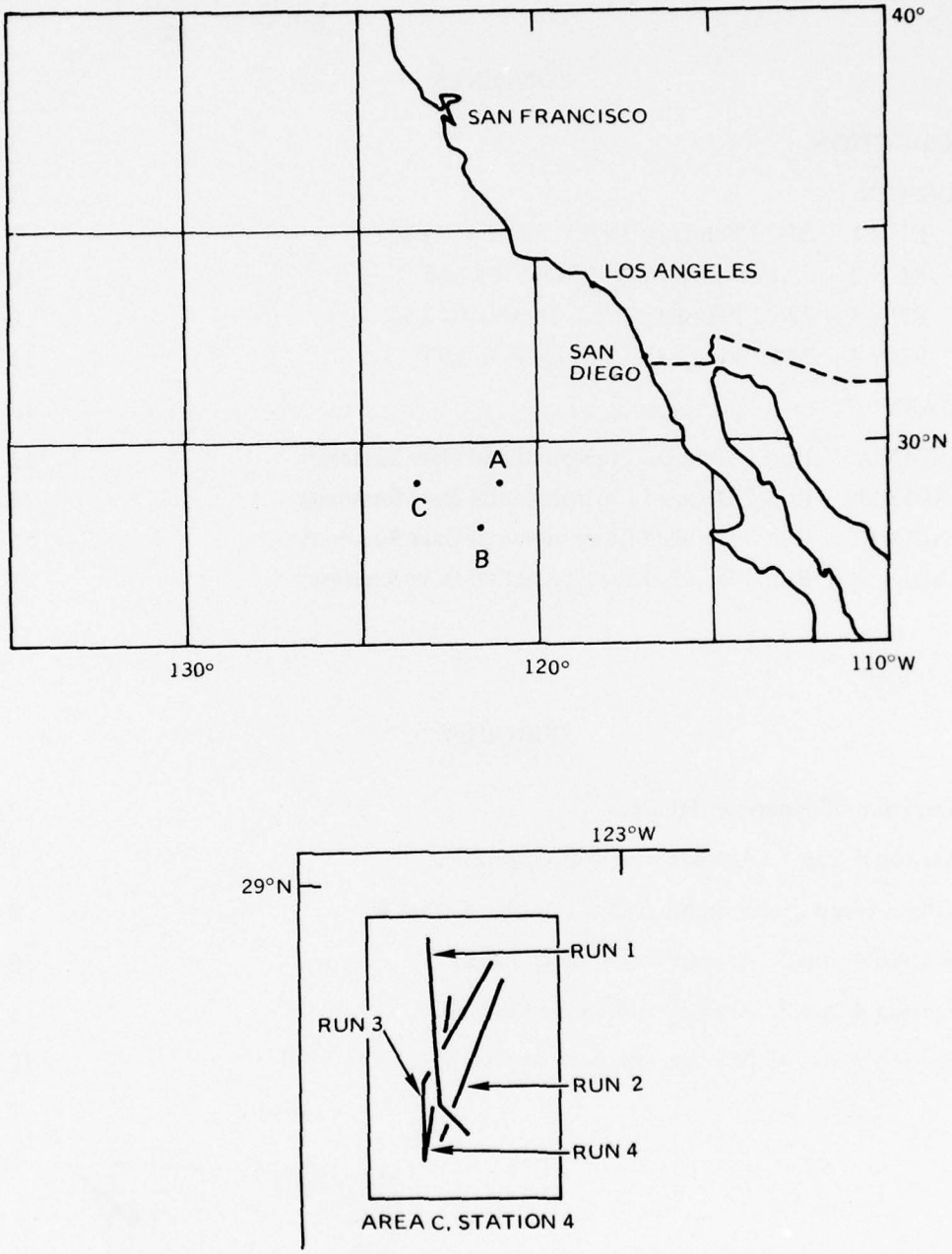

Figure 1. Location of experimental areas.

INTRODUCTION

This is the fifth in a series of five volumes describing the environmental measurements made during the SUDS I experiments. Volume I discusses the instrumentation used to make the required environmental measurements, the data reduction procedures, an accuracy analysis of the final measurements, and the reconstruction of the experimental tack charts. This volume is a detailed report of the environmental measurements applicable to the acoustic experiments conducted during station 4, where four acoustic experiments were completed. Figure 1 shows the location of the experiments and the track of the source ship. Source ship speed was 3 knots for all runs.

The detailed environmental data for each propagation loss run are summarized in the form of charts, plots, and tables in the appendices. Each appendix presents the same kind of data in the same sequence for all propagation loss runs. Additions and omissions are made as appropriate for the run described. Thus the first figure (A-1, B-1, etc.) is a chart showing the locations of source and receiver ships, selected propagation paths, and wind velocity. The second figure (A-2, B-2, etc.) is a chart showing the locations of XBT, thermistor chain, and Teletherm buoy measurements used to determine the distribution of sound speed and the locations of surface-wave measurements made by the Waverider buoy used to determine surface roughness. The balance of the figures and tables in the appendices are organized as follows:

Figure 3. Plot of selected sound-speed profiles from the surface to 250 m taken along the track of the source ship.* These are derived from the XBT and thermistor chain profiles whose locations are shown in Fig. 2. These profiles are used to identify any unusual changes in the horizontal distribution of sound speed, particularly with regard to vertical profile shape. These plots show sound speed versus depth, with the 1503-m/sec isospeed abscissa being located at the proper distance along the source ship track. The area containing sound speeds higher than 1503 m/sec is shaded. The number is the time in local standard time.

Figure 4. Plot of thermistor chain temperature measurements at 10 selected depths about 25 m apart from the surface to 242 m. Abscissas showing time, distance along source track, and acoustic range are also included. These plots are used to reveal any important horizontal temperature changes present during the acoustic experiments that might influence the experimental measurements.

**In this paper only computed sound speeds are reported. The computed sound speeds are obtained from Anderson's sound-speed equation (Naval Undersea Research and Development Center, NUC TP 243,* Sound Speed in Seawater as a Function of Realistic Temperature-Salinity-Pressure Domains, *by E. R. Anderson, August 1971). Discussions of sound-speed distributions present during the propagation loss measurements are based on the computed sound speeds.*

Figure 5. Plot of thermistor chain temperature measurements at the source depth or at two depths, 6 m apart, bracketing the source depth. Format and purpose of plots are the same as for Fig. 4.

Figure 6. Plot of sound-speed profiles derived from XBT, thermistor chain, and Teletherm buoy measurements. These profiles were made at identically the same time and are used to give a limited evaluation of the spatial change in profile shape present during the acoustic experiment. The plot format is the same as that used in Fig. 3.

Figure 7. Plot of Teletherm buoy temperature measurements. Also shown are the average temperature and standard deviation at each depth.

Figure 8. Plot of Waverider buoy measurements of wave height showing the standard deviation of 3-min averages of the wave height. The point is plotted at the beginning of the 3-min interval. The dashed horizontal line is the standard deviation of all wave height measurements made during the acoustic run. At the right is a histogram of the standard deviations.

Figure 9. Ogive of the standard deviation of surface-wave height for the 3-min averages presented in Fig. 8.

Figure 10. Plot of standard deviation of wave height as a function of wave periods from 1.25 to 16.7 sec.

The following additional figure is included for run 1:

Figure 11. Expanded sound-speed profile plots derived from thermistor chain measurements.

The following tables are also included in each appendix:

Table 1. Tabulated values of temperature as a function of standard hydrographic depths and time of day for all XBT, thermistor chain, and Teletherm buoy measurements used in the sound-speed distribution analysis. Also tabulated are the isothermal layer depth (ILD), temperature (T) of the ILD, and surface layer depth (SLD).

Table 2. Tabulated values of sound speed as a function of standard hydrographic cast depths to 400 m for all converted XBT, thermistor chain, and Teletherm buoy temperature measurements used in the analysis. Also tabulated are the surface channel depth (SC), depressed channel depths (DC), refractive channel depths (RC), and depths of the maxima below surface channels and depressed channels (MAX).

Table 3. Tabulated values of average sound speed at standard depths from the surface to 1500 m. Also included are the number of observations and the depths of the surface channel, depressed channels, refractive channels, sound speed maxima, and the axis of minimum sound speed. The average values are obtained from thermistor chain measurements (0-250 m),

DISCUSSION

RUN 1 – 21-22 February 1972 2342-0647 LST

The plots of the individual sound-speed profiles plotted in Fig. A-3 suggest a sound-speed profile boundary was crossed between 0100 and 0300 LST. Figure A-11, a plot of sound-speed profiles taken at 10-min intervals between 0100 and 0300 LST, does not support this conclusion. The profiles show surface channels to varying depths and intermittent small depressed channels.

Figure 2 is a plot of the average sound speeds listed in Table A-3. The details of the average sound-speed distribution in the upper 200 m are shown in Fig. 3. In addition, the source and receiver depths are shown in Fig. 3. The average sound-speed profile is characterized by a 17-m surface channel underlain by a small negative sound-speed gradient to a depth of 80 m. During this run usable temperature measurements were recorded by Teletherm buoys 5 and 6. The remainder of the buoys did not give any usable measurements. The measurements made by buoys 5 and 6 are plotted in Fig. A-7. As indicated by the random scatter of the temperature measurements, buoy 5 appears to be the most accurate. Of interest is the temperature stability in the near-surface layers.

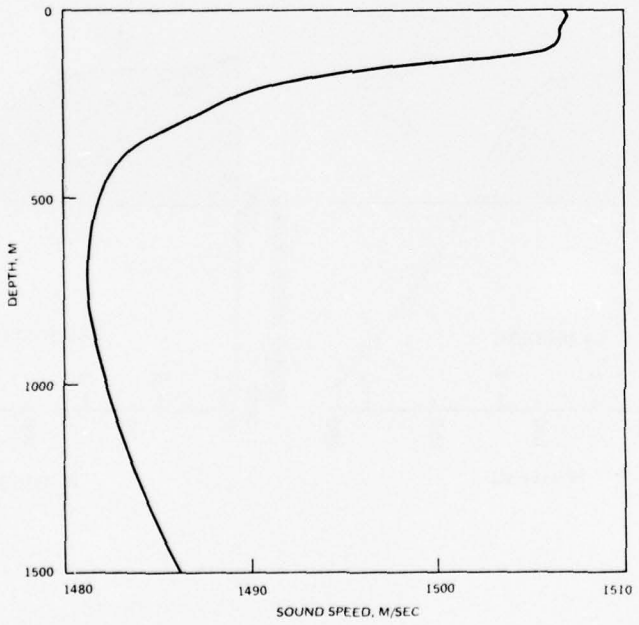

Figure 2. Station 4, run 1. Average sound-speed profile.

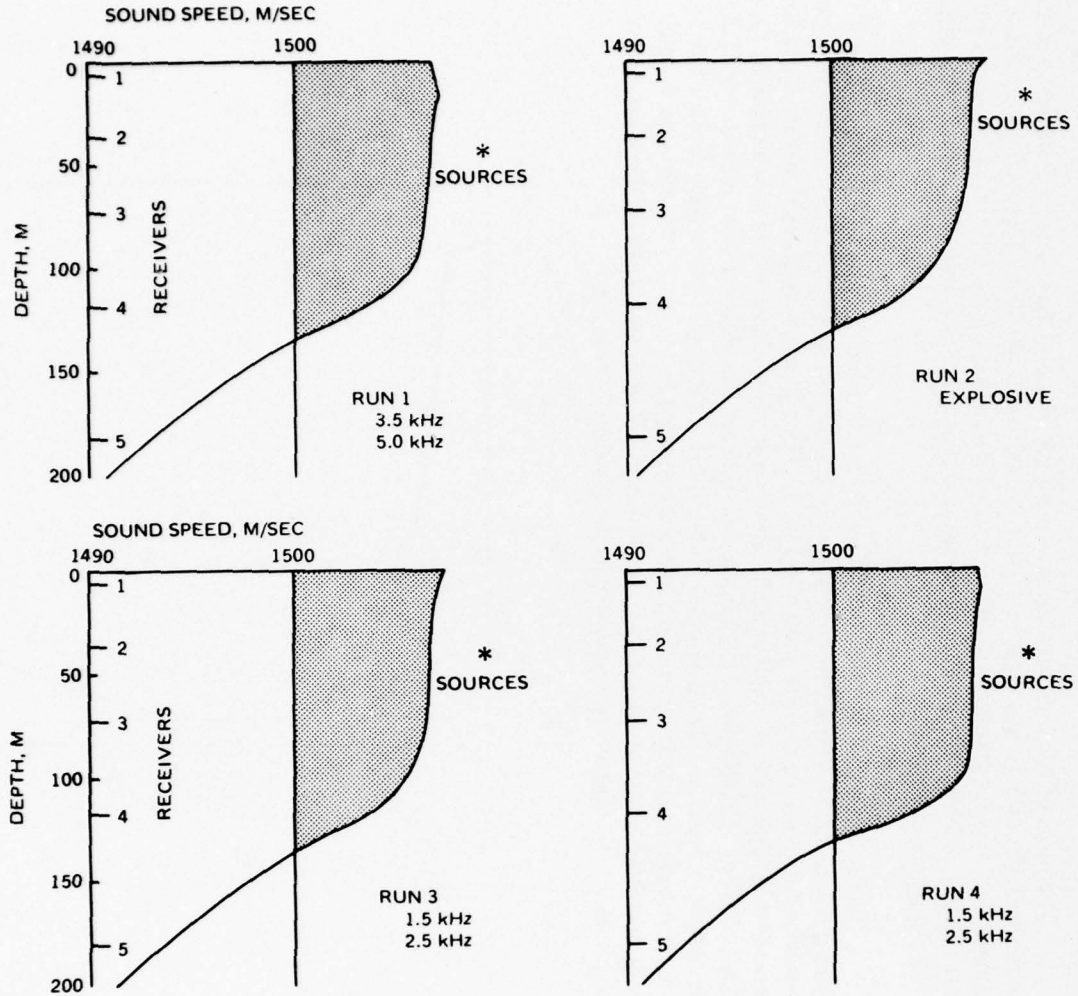

Figure 3. Sound-speed profile summary for acoustic station 4.

During this run the *Lee* reported 5- to 6-knot winds, 1-ft waves, and 8- to 10-ft swell, while the *DeSteiguer* reported light airs to 5-knot winds, calm to ripples, and 4-ft swell. Waverider buoy measurements were obtained for the complete run. Table A-5 and Figs. A-8 and A-9 present the standard deviation of the Waverider buoy measurements for 3-min averages. Also shown is the standard deviation for the complete 7-hr 4-min record. The standard deviation of the 3-min averages varied from 29 to 64 cm, with 88.7 percent between 30 and 55 cm. To detect any change in sea-surface roughness during the acoustic run, the Waverider buoy record was divided into seven 60-min records. A spectrum analysis was made on each of these subsets. In preparing these spectra, a bandwidth of 0.0053 Hz (19 harmonics) was used. The 90-percent confidence limits are 0.67 to 1.29 (38 degrees of freedom). The individual spectra did indicate a change with time. Figure A-10a presents the spectrum from 2342 to 0041 LST, the first hour of the run. Most of the sea-surface roughness is centered at a wave period of 11.8 sec, with secondary peaks at 10.5, 9.0 and 7.8 sec. These periods are associated with the 4- to 8-ft swell reported by the *Lee* and *DeSteiguer*. Figure A-10b is the spectrum from 0042 to 0241 LST. This spectrum shows that the sea-surface roughness centered at a wave period of 11.5 sec has decreased from that present during the previous hour. In addition, the secondary swell peaks have decayed and are not detectable. Figure A-10c shows the spectrum from 0242 to 0641 LST. Most of the sea-surface roughness is still centered at 11.8 sec. However, a new train of swell has moved into the area, with a peak centered at 14.7 sec. Table A-6 contains a tabulation of the data plotted in Fig. A-10.

RUN 2 – 22 February 1972 1210-1705 LST

The plots of the individual sound-speed profiles plotted in Fig. A-3 suggest that the experiment was conducted in a single sound-speed profile volume. These profiles show surface channels to varying depths and intermittent small depressed channels.

Figure 4 is a plot of the average sound speeds listed in Table B-3. The details of the average sound-speed distribution in the upper 200 m are presented in Fig. 3. The average sound-speed profile is characterized by a negative sound-speed gradient from the surface to 700 m, the depth of the deep sound-speed minimum. There are no surface or depressed channels in the average profile. During this run, usable temperature measurements were recorded on Teletherm buoys 5 and 6. The remainder of the buoys did not give any usable data. The measurements by buoys 5 and 6 are plotted in Fig. B-7.

During this run the *Lee* reported 5- to 8-knot winds, 1-ft waves, and 8-ft swell, while the *DeSteiguer* reported 6-knot winds, ripples, and 4-ft swell. Waverider buoy measurements were obtained from 1210 to 1506 LST. No measurements were obtained from 1507 LST to the end of the run at 1705 LST. Table B-5 and Figs. B-8 and B-9 present the standard deviation of the sea-surface roughness for 3-min averages. Also shown is the standard deviation for the complete 2-hr 56-min record. The standard deviation of the 3-min averages varied from 29 to 77 cm, with 88.0 percent between 30 and 60 cm. To detect any change in sea-surface roughness during the acoustic run, the Waverider buoy record was divided into three 56-min records. A spectrum analysis was made on each of these subsets. In preparing these spectra, a bandwidth of 0.0051 Hz (17 harmonics) was used. The 90-percent confidence limits are 0.65 to 1.40 (34 degrees of freedom). The individual spectra did indicate a change with time. Figure B-10a presents the spectrum from 1214 to 1309 LST, the first hour of the run. Most of the sea-surface roughness is centered in a wave-period band from

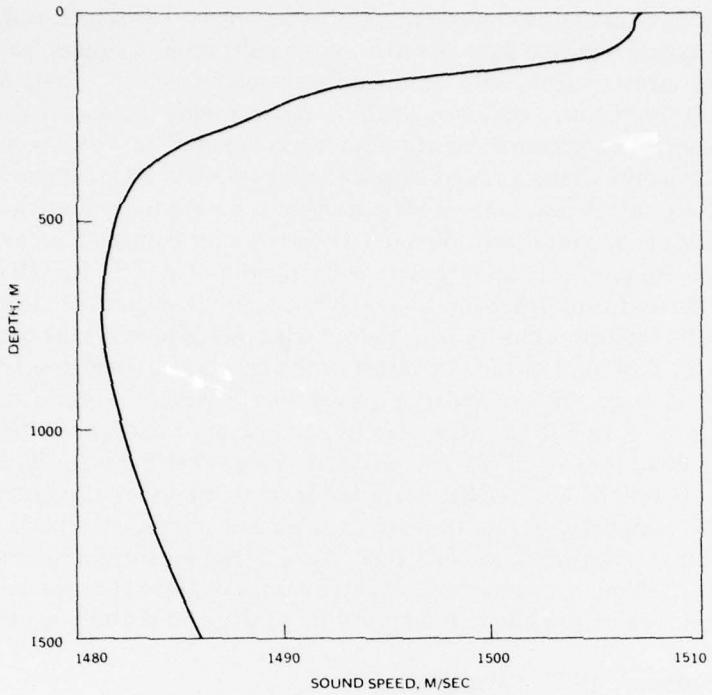

Figure 4. Station 4, run 2. Average sound-speed profile.

13.5 to 15.5 sec. These wave periods are associated with the 4- to 8-ft swell reported by the *Lee* and *DeSteiguer*. Figure B-10b is the spectrum from 1310 to 1405 LST. This spectrum shows most of the sea-surface roughness centered at a 14.0-sec wave period, with secondary wave periods appearing at 9.8 and 10.8 sec. Figure B-10c shows the spectrum from 1406 to 1501 LST. Most of the sea-surface roughness is still centered at 14.0 sec. However, the secondary-swell wave trains present during the previous hour have decayed and are not detectable. Table B-6 lists the data plotted in Fig. B-10.

RUN 3 – 22-23 February 1972 1810-0104 LST

The plots of the individual sound-speed profiles plotted in Fig. C-3 suggest that the experiment was conducted in a single sound-speed profile volume. These profiles show surface channels at depths varying from 0 to 67 m and intermittent small depressed channels at depths varying from 10 to 75 m.

Figure 5 is a plot of the average sound speeds listed in Table C-3. The details of the average sound-speed distribution in the upper 200 m are shown in Fig. 3. The average sound-speed profile is characterized by a negative sound-speed gradient from the surface to 700 m, the depth of the deep sound-speed minimum. The average profile is very similar to the run 2 average profile. During this run usable temperature measurements were recorded by Teletherm buoys 5 and 6. The remainder of the buoys did not record any usable data. The measurements recorded by buoys 5 and 6 are plotted in Fig. C-7.

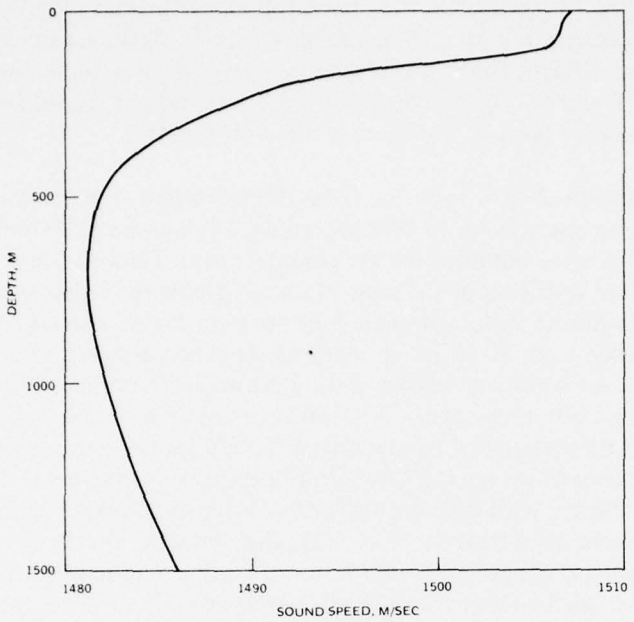

Figure 5. Station 4, run 3. Average sound-speed profile.

During run 3 the *Lee* reported 4- to 8-knot winds, 1-ft waves, and 7- to 8-ft swell, while the *DeSteiguer* reported 7- to 8-knot winds, 1-ft waves, and 3- to 4-ft swell. Sea-surface roughness measurements were obtained by the Waverider buoy from 1900 to 0104 LST. No measurements were obtained from 1800 to 1859 LST, the first hour of the run. Table C-5 and Figs. C-8 and C-9 present the standard deviation of the sea-surface roughness for 3-min averages. Also shown is the standard deviation for the complete 6-hr 4-min record. The standard deviation of the 3-min averages varied from 29 to 64 cm, with 78.6 percent between 30 and 50 cm. To detect any change in sea-surface roughness during the acoustic run, the Waverider buoy record was divided into six 60-min records. A spectrum analysis was made on each of these subsets. In preparing these spectra a bandwidth of 0.0053 Hz (19 harmonics) was used. The 90-percent confidence limits are 0.67 to 1.39 (38 degrees of freedom). The individual spectra did not indicate any change in spectra with time. The ensemble average spectrum for the six 60-min spectra is shown in Fig. C-10. Most of the sea-surface roughness is in a wave-period band centered at 12.6 sec, with a secondary peak at 7.8 sec. The 12.6-sec peak is associated with the 3- to 8-ft swell reported by the *Lee* and *DeSteiguer*. Table C-6 lists the data plotted in Fig. C-10.

RUN 4 – 23 February 1972 0116-0632 LST

The plots of the individual sound-speed profiles plotted in Fig. D-3 suggest that the experiment was conducted in a single sound-speed profile volume. These profiles show surface channels to varying depths and intermittent small depressed channels.

Figure 6 is a plot of the average sound speeds listed in Table D-3. The details of the average sound-speed distribution in the upper 200 m are shown in Fig. 3. The average sound-speed profile is characterized by a 10-m surface channel. There are no depressed channels in the average profile. During this run usable temperature measurements were recorded by Teletherm buoys 5 and 6. The remainder of the buoys did not record any usable data. The measurements made by buoys 5 and 6 are plotted on Fig. D-7.

During this run the *Lee* reported 8- to 10-knot winds, 1-ft waves, and 8-ft swell, while the *DeSteiguer* reported 8- to 10-knot winds, 1-ft waves and 3- to 4-ft swell. Waverider buoy measurements were obtained for the complete run. Table D-5 and Figs. D-8 and D-9 present the standard deviation of the sea-surface roughness for 3-min averages. Also shown is the standard deviation for the complete 5-hr 16-min record. The standard deviation of the 3-min averages varied from 30 to 54 cm, with 85.0 percent between 30 and 50 cm. To detect any change in sea-surface roughness during the acoustic run, the Waverider buoy record was divided into five 63-min records. A spectrum analysis was made on each of these subsets. In preparing these spectra a bandwidth of 0.0056 Hz (21 harmonics) was used. The 90-percent confidence limits are 0.67 to 1.36 (42 degrees of freedom). The individual spectra did indicate a change with time during the last hour of the experiment. Figure D-10a presents the spectrum from 0116 to 0527 LST, the first 4 hr 11 min of the run. Most of the sea-surface roughness is contained in two trains of swell centered at 12.5 and 15.7 sec. These wave periods are associated with the 3- to 8-ft swell reported by the *Lee* and *DeSteiguer*. Figure D-10b is the spectrum from 0528 to 0630 LST. This spectrum also shows two swell trains; however, the 12.5-sec swell has shifted to about 11.7 sec. During the last hour, wind waves centered at about 3.2 sec appeared. The wind wave is the result of the local 8- to 10-knot winds. Table D-6 lists the data plotted in Fig. D-10.

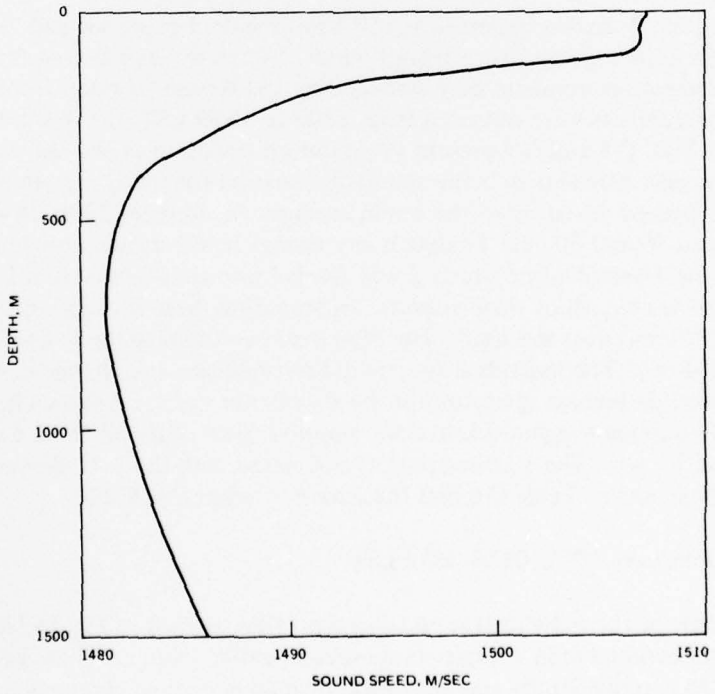

Figure 6. Station 4, run 4. Average sound-speed profile.

SUMMARY

Four propagation loss runs, including three CW runs and one explosive run, were made over a 30-hr 50-min period from 21 February 2342 LST to 23 February 0632 LST. Oceanographic measurements made in the area during these experiments showed the experimental area contained a single water mass.

The average sound-speed profiles for runs 1 and 4 had small surface sound channels, 17 m during run 1 and 10 m during run 4. For runs 2 and 3, the average sound-speed profiles were characterized by negative sound-speed gradients from the surface to the depth of the deep sound-speed minimum at 700 m.

Mild weather prevailed during the time the propagation loss runs were made. Wind speeds varying from near calm to 10 knots produced 1-ft waves, which were accompanied by 4- to 8-ft swell. Spectral analysis of the sea-surface roughness measurements made by the Waverider buoy showed that the spectra changed with time during runs 1, 2, and 4 and did not change with time during run 3. During station 4, most of the sea-surface roughness was in the 11- to 16-sec wave-period band. However, the predominant swell periods present during any given run varied during the several runs.

APPENDIX A

STATION 4 RUN 1

DETAILED ENVIRONMENTAL DATA SUMMARY

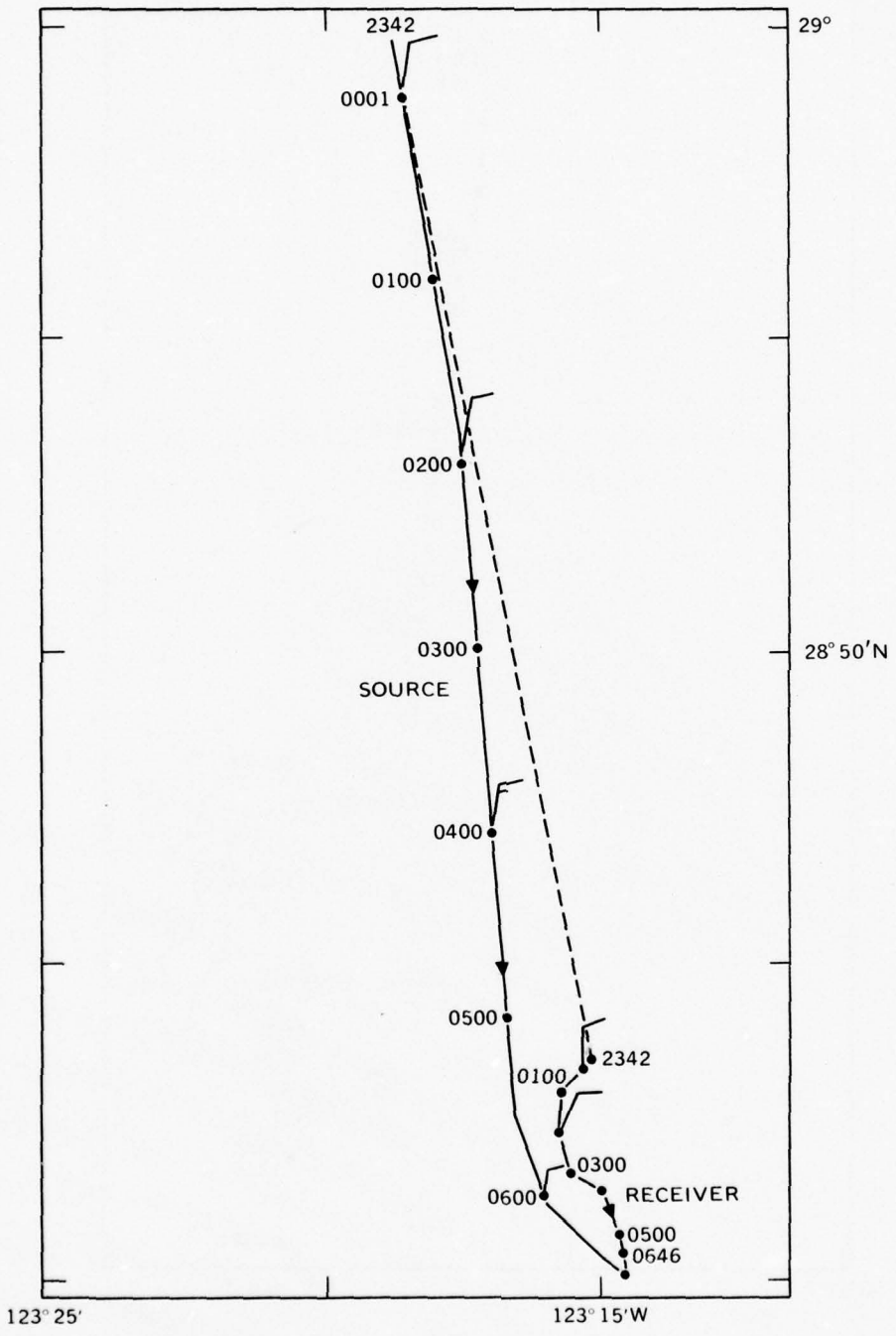

Figure A-1. Station 4, run 1. Location of source and receiving ships, 2342 LST propagation path (---), and wind velocity (10-knot east wind, 1 bar = 5 knots).

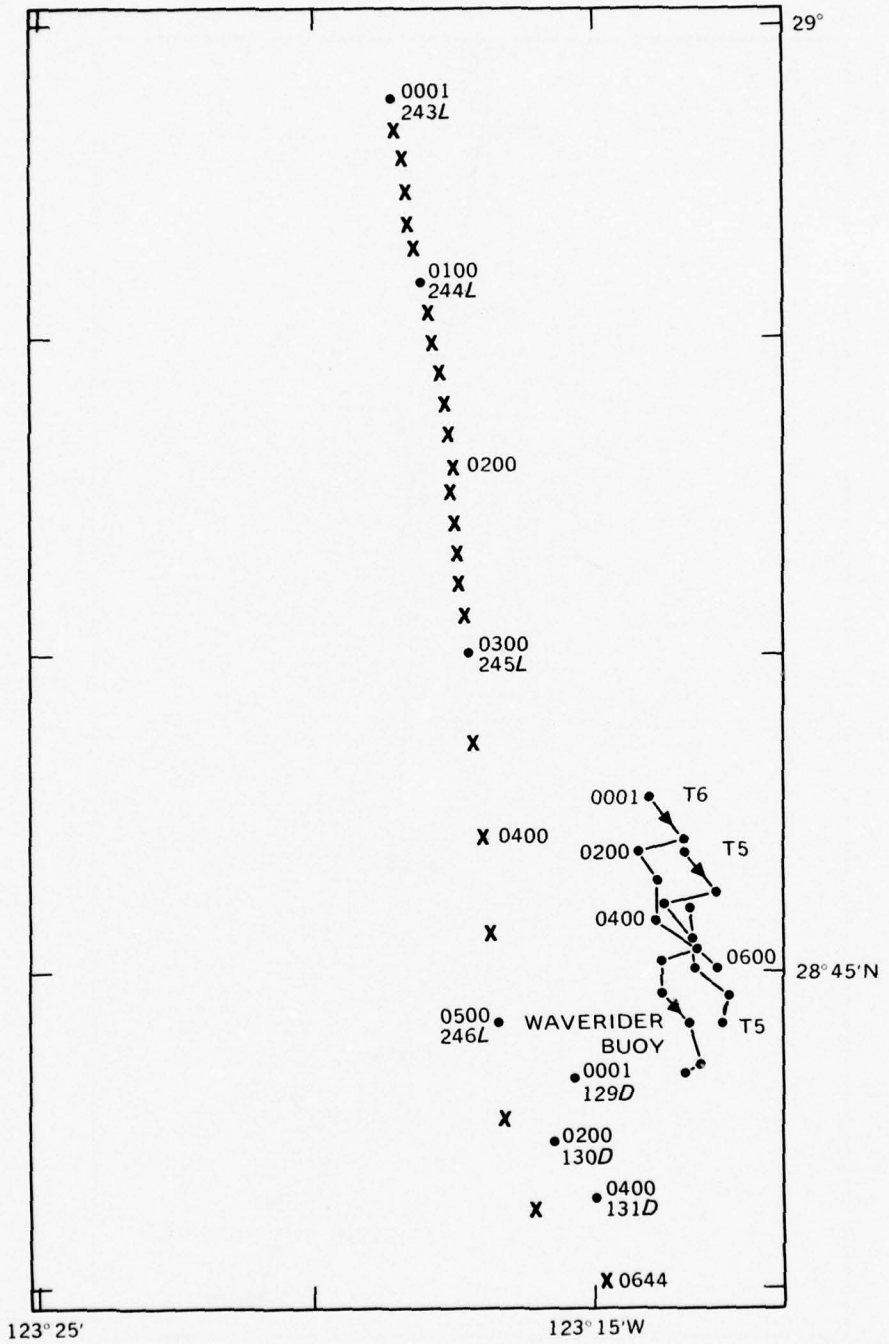

Figure A-2. Station 4, run 1. Location of XBT (·), thermistor chain (X), Teletherm buoy (T), and Waverider buoy measurements. The letter following the XBT number denotes the ship which took the measurement (*L: Lee, D: DeSteiguer*). The times shown are LST.

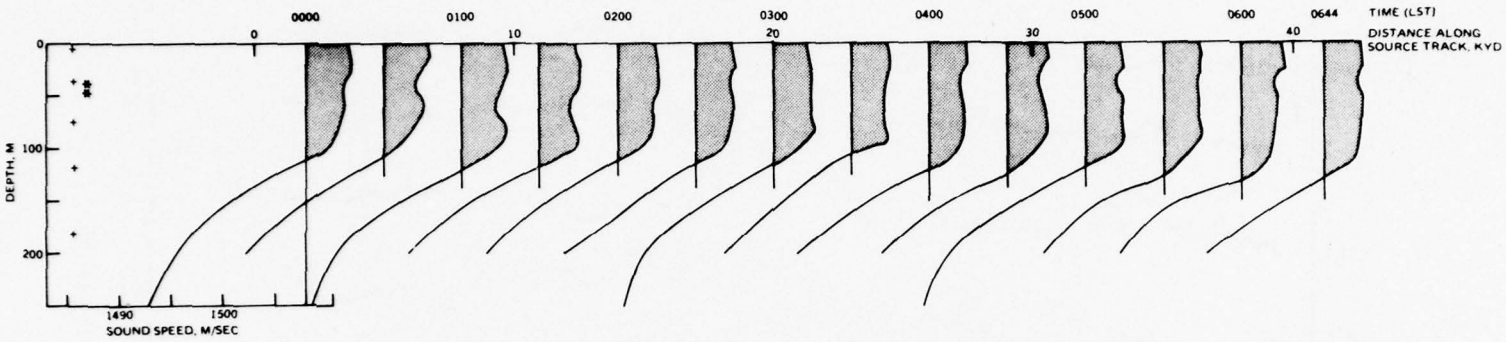

Figure A-3. Station 4, run 1. Sound-speed profiles along track of source ship derived from XBT and thermistor chain data. Source depth (*), receiver depth (+).

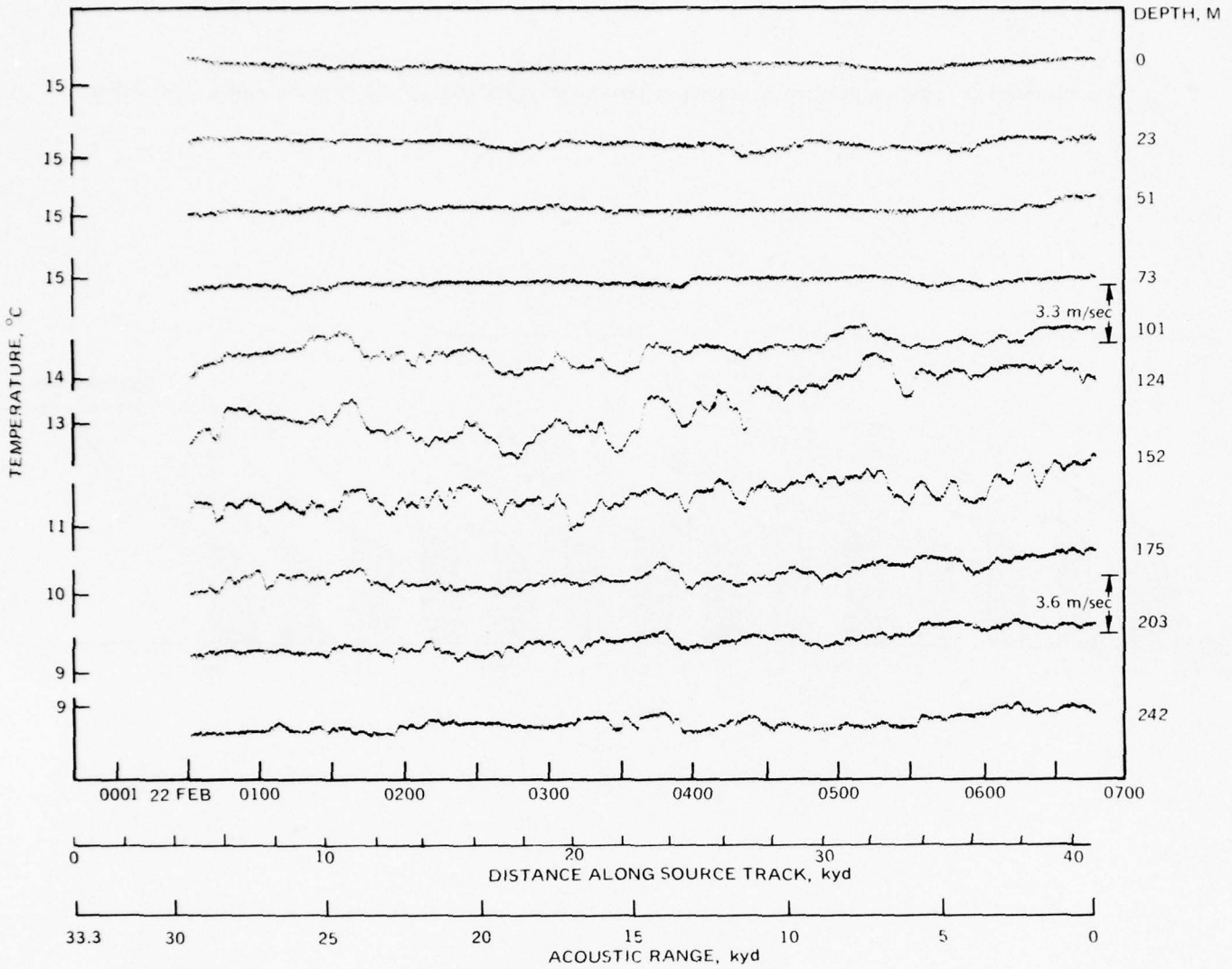

Figure A-4. Station 4, run 1. Thermistor chain temperature measurements at selected depths. Time is LST.

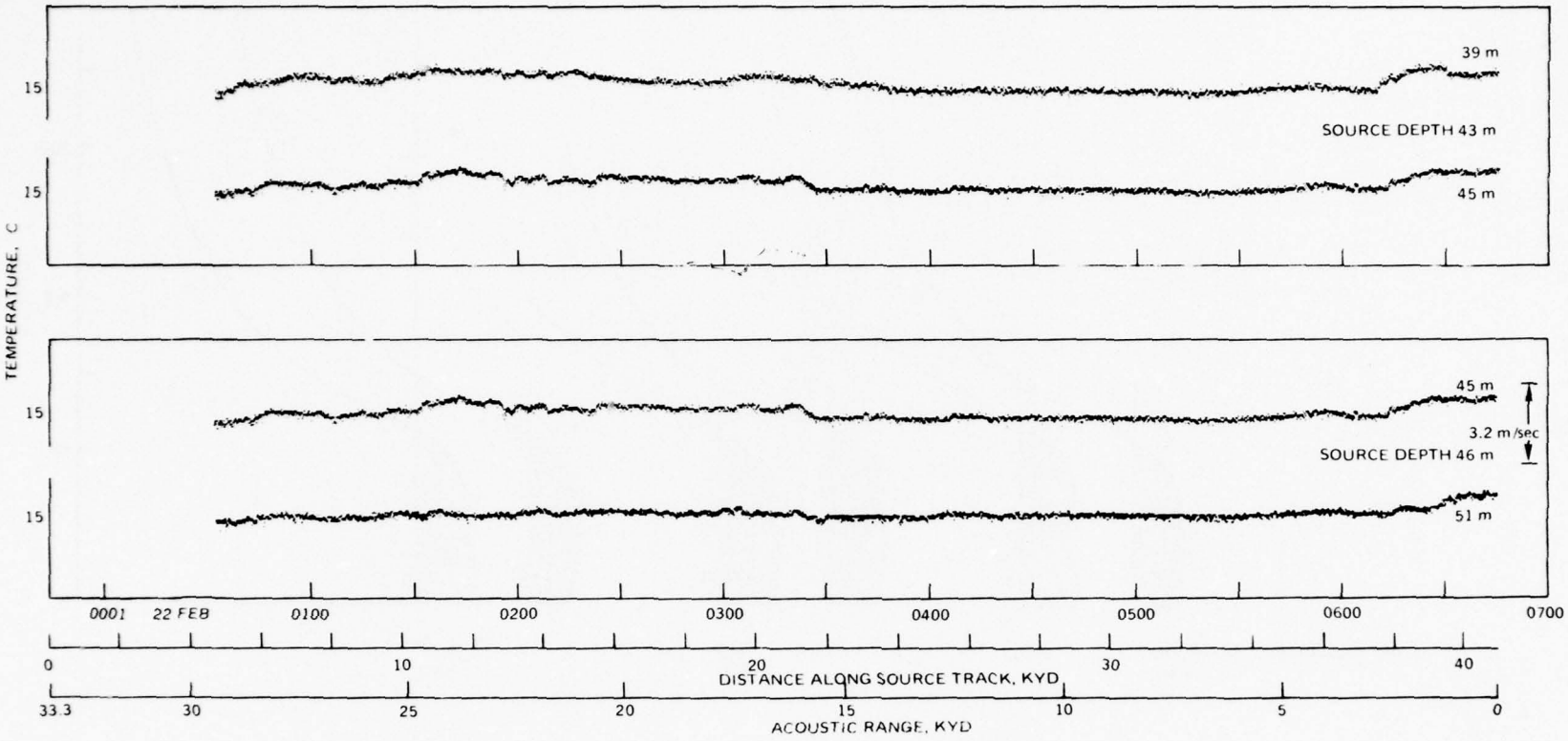

Figure A-5. Station 4, run 1. Temperatures above and below source. Time is LST.

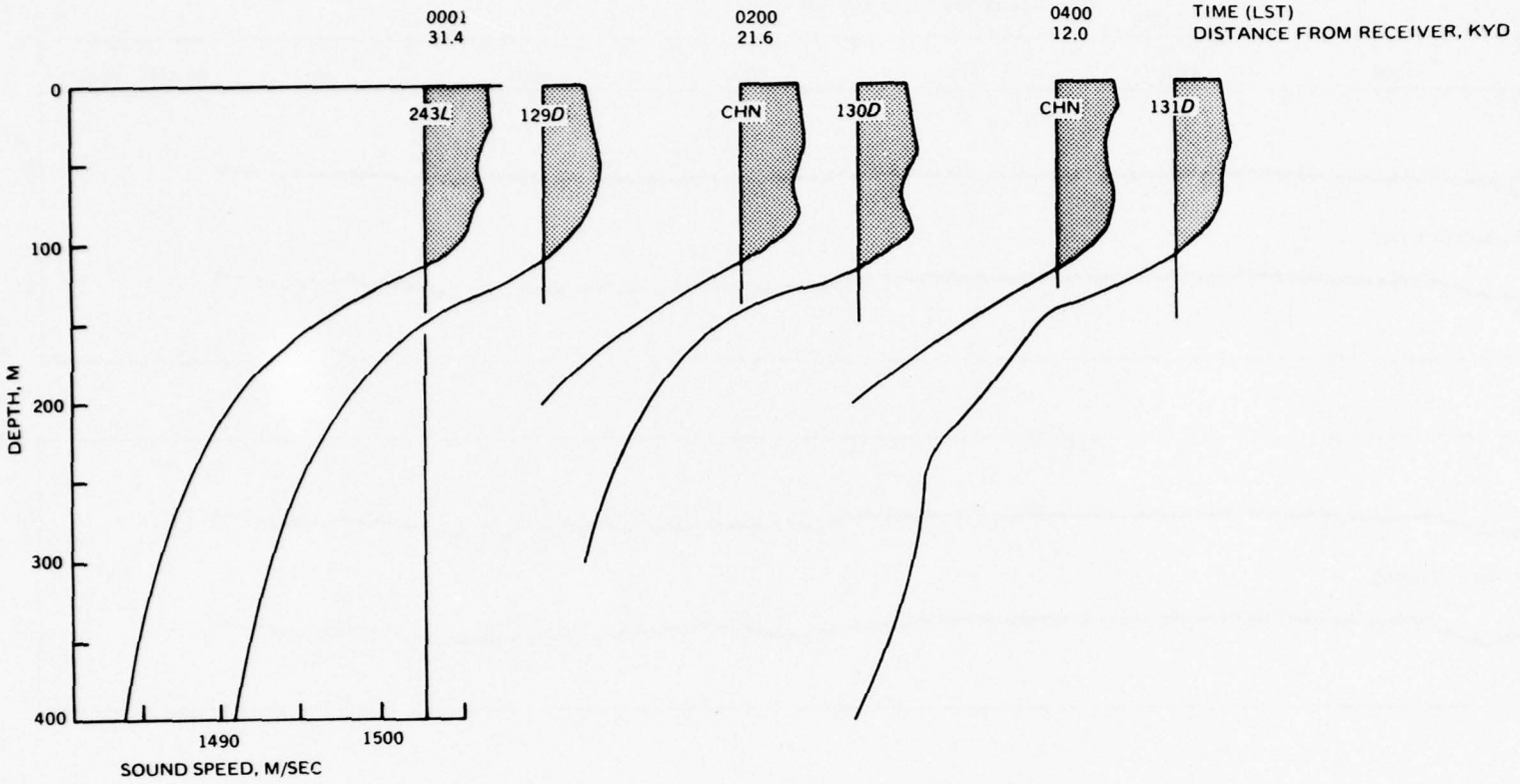

Figure A-6. Station 4, run 1. Spatial change in sound-speed profile.

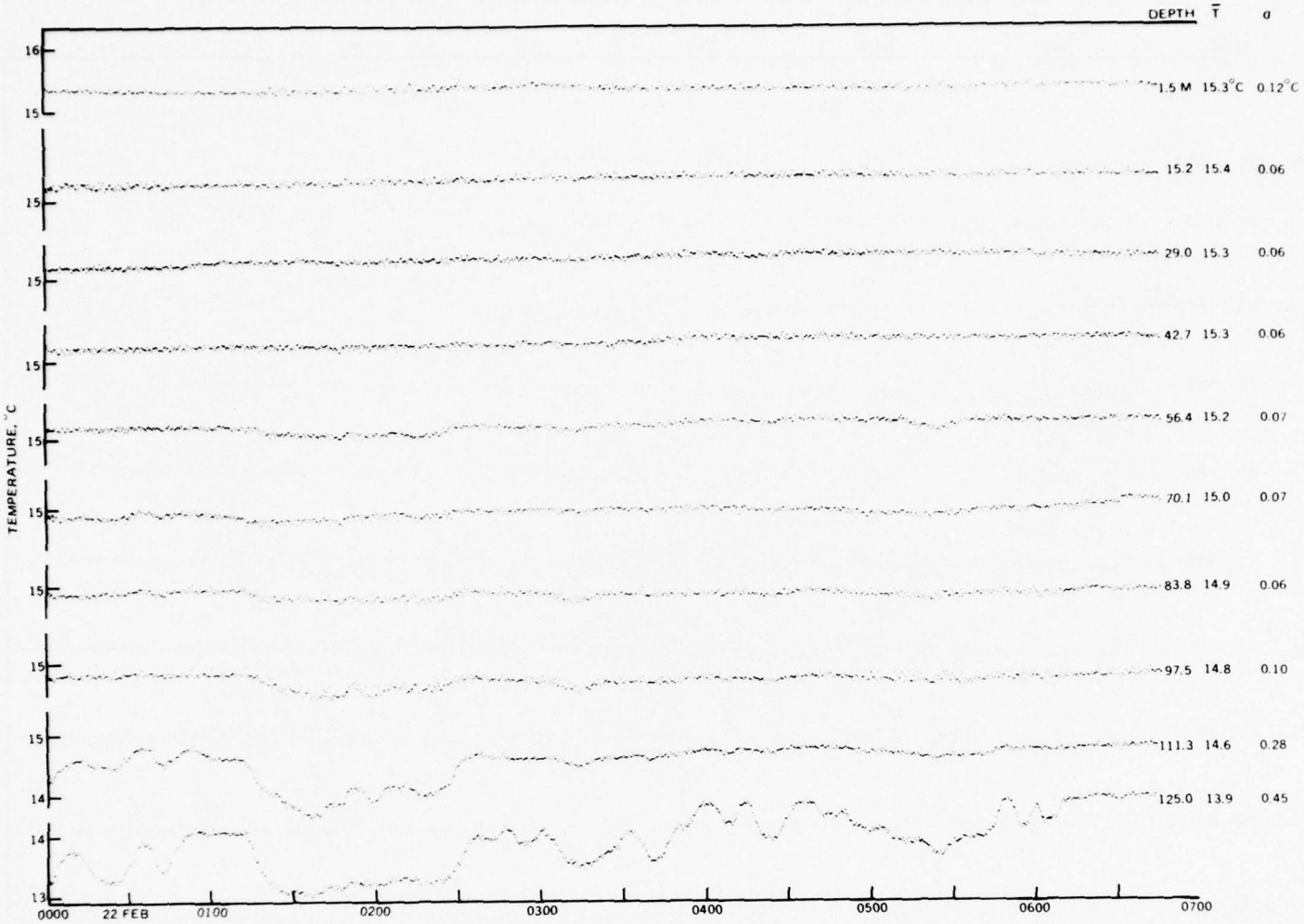

Figure A-7a. Station 4, run 1. Teletherm buoy 5 temperature measurements (n = 2379). Time is LST.

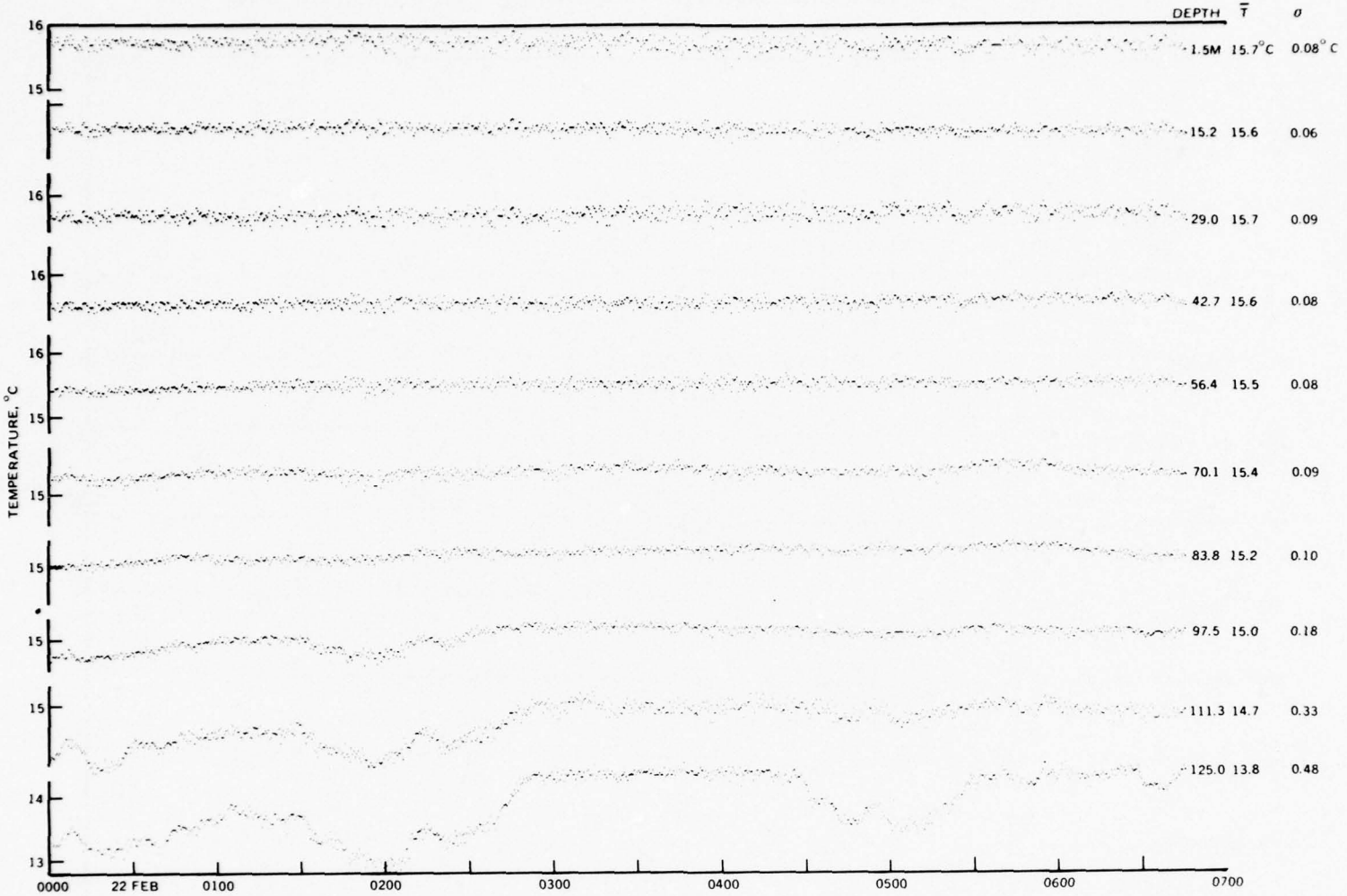

Figure A-7b. Station 4, run 1. Teletherm buoy 6 temperature measurements (n = 2509). Time is LST.

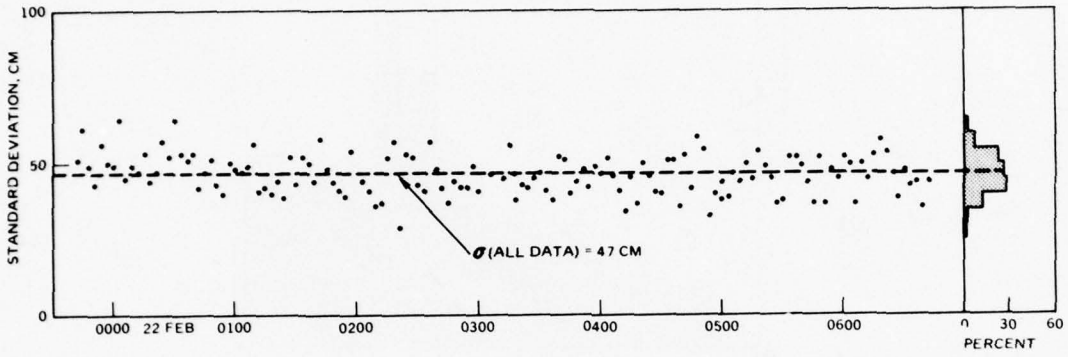

Figure A-8. Standard deviation of surface-wave height for 3-min averages. Time is LST.

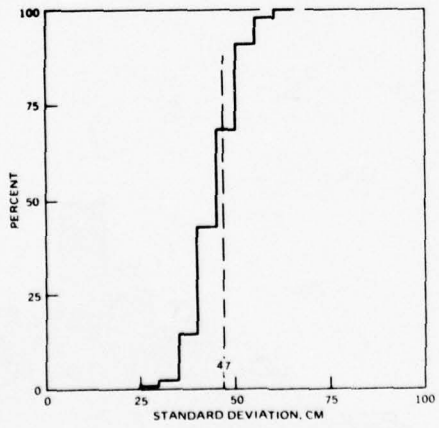

Figure A-9. Station 4, run 1. Ogive of standard deviation of surface wave height for 3-min averages.

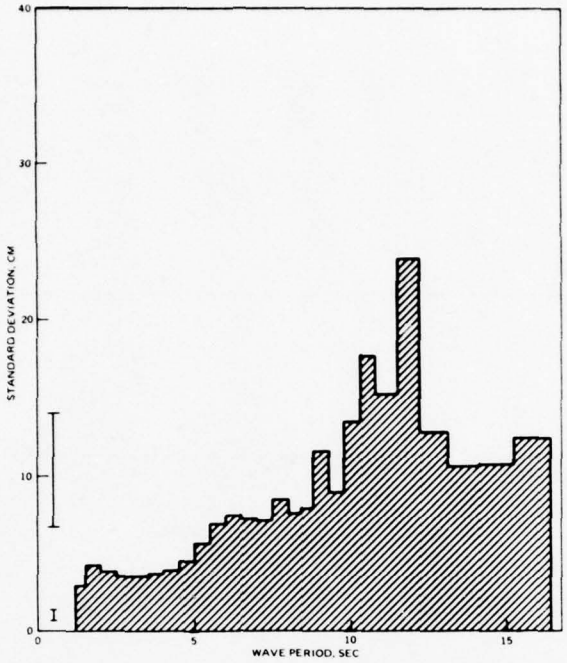

Figure A-10a. Station 4, run 1. Standard deviation of wave height as a function of wave period (21-22 February 1972, 2342-0041 LST).

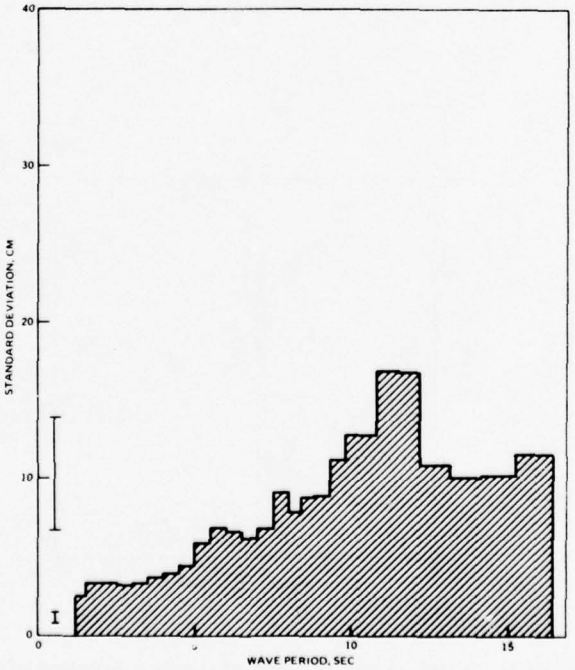

Figure A-10b. Station 4, run 1. Standard deviation of wave height as a function of wave period (22 February 1972, 0042-0241 LST).

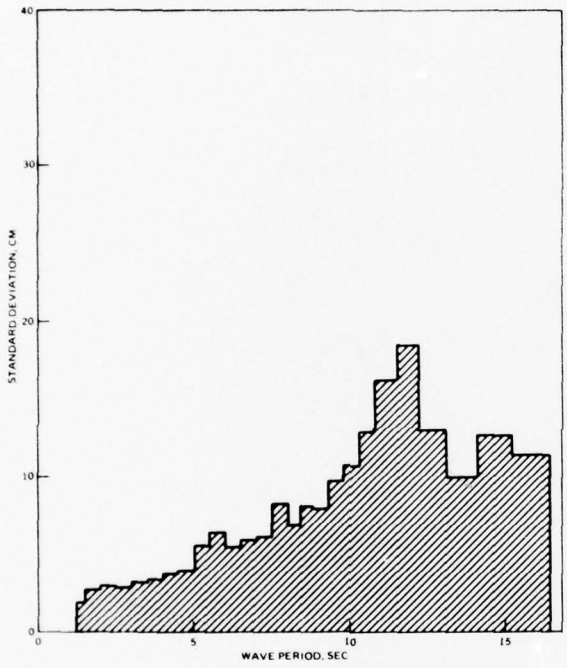

Figure A-10c. Station 4, run 1. Standard deviation of wave height as a function of wave period (22 February 1972, 0242-0641 LST).

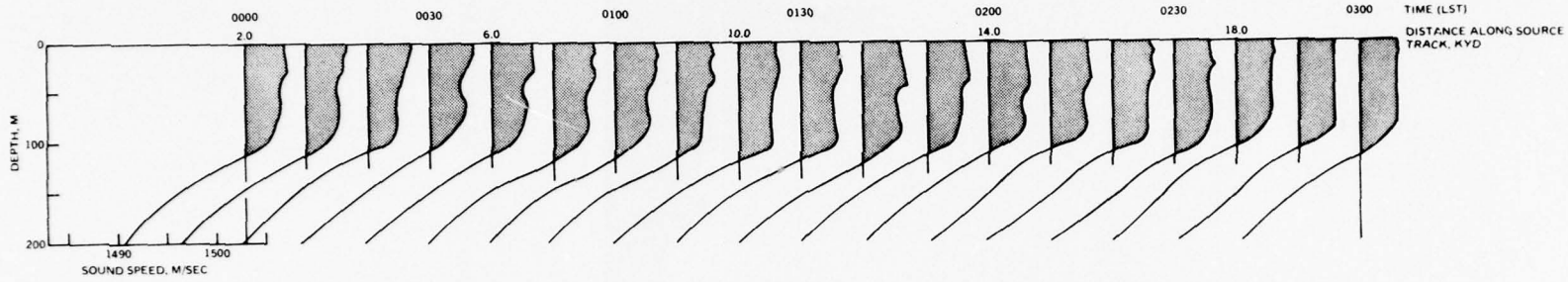

Figure A-11. Station 4, run 1. Expanded sound-speed profile plots.

Table A-1. Temperature Profiles (°C),
Station 4 Run 1 (21-22 February 1972 2342-0640 LST).

XBT MEASUREMENTS

Depth, m	243L 0001	244L 0100	245L 0300	246L 0500	129D 0000	130D 0200	131D 0400
0	15.5	15.5	15.3	15.3	15.1	15.2	15.2
10	15.5	15.5	15.3	15.3	15.1	15.2	15.2
20	15.5	15.5	15.3	15.3	15.1	15.2	15.2
30	15.4	15.5	15.3	15.1	15.1	15.2	15.2
50	15.1	15.1	15.2	15.1	15.1	15.1	15.0
75	14.9	15.1	15.1	15.0	14.8	14.8	14.8
100	14.4	14.8	14.5	14.7	14.1	14.5	14.2
125	12.8	13.4	13.1	13.1	12.7	13.0	12.7
150	11.4	11.8	11.8	11.7	11.2	10.9	11.0
200	9.6	9.7	9.6	9.5	9.5	9.1	9.6
250	8.6	8.8	8.8	8.5	8.5	8.4	8.4
300	7.9	8.0	7.9	7.8	7.8	7.7	7.9
400	6.8	6.8	6.6	6.7	6.6		6.5
ILD	28	30	30	26	50	40	40
T	15.5	15.5	15.3	15.3	15.1	15.2	15.2
SLD	68	98	85	88	92	96	88

THERMISTOR CHAIN MEASUREMENTS

Depth, m	0010	0020	0030	0040	0050	0100	0110	0120	0130
0	15.5	15.6	15.6	15.5	15.5	15.5	15.4	15.4	15.4
10	15.4	15.5	15.5	15.5	15.5	15.5	15.5	15.4	15.4
20	15.3	15.4	15.4	15.5	15.4	15.4	15.4	15.4	15.4
30	15.2	15.2	15.2	15.4	15.4	15.4	15.4	15.3	15.3
50	15.0	15.0	15.0	15.0	15.0	15.0	15.1	15.1	15.0
75	14.9	14.8	14.9	14.9	14.9	14.9	14.9	14.9	14.9
100	14.2	14.4	14.1	14.3	14.5	14.4	14.6	14.7	14.8
125	12.8	12.5	12.7	12.8	13.2	13.1	13.1	13.1	13.1
150	11.4	11.4	11.4	11.5	11.5	11.5	11.6	11.6	11.6
200	9.4	9.5	9.4	9.5	9.5	9.5	9.5	9.5	9.6
ILD	6	6	11	28	11	11	11	23	39
T	15.5	15.6	15.6	15.5	15.5	15.5	15.4	15.4	15.4
SLD	73	85	62	68	79	79	96	101	101

Table A-1, continued.

Depth, m	0140	0150	0200	0210	0220	0230	0240	0250	0300
0	15.4	15.4	15.4	15.4	15.4	15.4	15.4	15.4	15.4
10	15.4	15.4	15.4	15.4	15.4	15.4	15.4	15.3	15.4
20	15.4	15.4	15.4	15.4	15.3	15.4	15.3	15.3	15.3
30	15.4	15.4	15.4	15.4	15.4	15.2	15.2	15.2	15.3
50	15.1	15.1	15.2	15.1	15.1	15.1	15.1	15.1	15.2
75	15.0	14.9	15.0	14.9	15.0	15.0	15.0	15.0	15.0
100	14.6	14.5	14.4	14.4	14.6	14.6	14.1	14.2	14.3
125	13.3	12.9	12.9	12.6	12.8	13.0	12.5	12.7	13.0
150	11.8	11.6	11.6	11.7	11.8	11.9	11.4	11.7	11.6
200	9.6	9.5	9.6	9.7	9.5	9.6	9.6	9.7	9.7
ILD	45	39	39	39	39	23	11	23	17
T	15.4	15.4	15.4	15.4	15.4	15.4	15.4	15.3	15.4
SLD	85	79	79	85	85	79	79	85	85

Depth, m	0330	0400	0430	0530	0600	0644
0	15.4	15.4	15.4	15.4	15.5	15.5
10	15.4	15.4	15.4	15.3	15.5	15.5
20	15.4	15.3	15.3	15.3	15.4	15.5
30	14.3	15.2	15.1	15.2	15.2	15.3
50	15.0	15.0	15.1	15.1	15.1	15.3
75	14.9	15.0	15.1	15.0	14.9	15.1
100	14.2	14.6	14.6	14.6	14.6	14.9
125	12.6	13.3	13.6	13.7	13.9	13.9
150	11.6	11.9	11.9	11.8	11.7	12.5
200	9.7	9.6	9.7	9.9	9.9	10.1
ILD	23	17	17	11	23	20
T	15.4	15.4	15.4	15.4	15.5	15.5
SLD	96	73	85	90	96	107

Table A-2. Computed Sound-Speed Profiles (m/sec),
Station 4 Run 1 (21-22 February 1972 2342-0604 LST).

XBT MEASUREMENTS

Depth, m	043L 0001	244L 0100	245L 0300	246L 0500	129D 0000	130D 0200	131D 0400
0	1506.9	1506.9	1506.3	1506.3	1506.6	1506.0	1506.0
10	07.1	07.1	06.4	06.4	05.8	06.1	06.1
20	07.2	07.2	06.6	06.6	06.0	06.3	06.3
30	07.1	07.4	06.8	06.1	06.1	06.5	06.5
50	06.5	06.5	06.8	06.5	06.5	06.5	06.2
75	06.2	06.9	06.9	06.6	05.9	05.9	05.9
100	05.1	06.5	05.5	06.1	04.1	05.5	04.4
125	00.2	02.3	01.3	01.3	1499.9	00.9	1499.9
150	1495.8	1497.2	1497.2	1496.9	95.1	1494.1	94.4
200	90.5	90.8	90.5	90.1	90.1	89.8	90.5
250	87.8	88.6	88.6	87.5	87.5	87.1	87.1
300	86.2	86.5	86.2	85.8	85.8	85.4	86.2
400	83.7	83.7	81.2	83.3	82.9		82.4
SC	28	30	28	26	50	40	40
DC	50	60	60	30		68	
MAX	68	80	85	88		96	

THERMISTOR CHAIN MEASUREMENTS

Depth, m	0010	0020	0030	0040	0050	0100	0110	0120
0	1506.8	1507.1	1507.1	1506.9	1506.8	1506.8	1506.7	1506.7
10	06.7	07.0	07.2	07.0	07.0	07.1	07.0	06.8
20	06.7	06.8	06.9	07.1	06.9	07.0	06.9	06.9
30	06.4	06.5	06.4	06.9	07.1	07.0	07.1	06.9
50	06.0	06.0	06.2	06.2	06.3	06.3	06.4	06.4
75	06.2	05.9	06.1	06.3	06.3	06.4	06.1	06.2
100	04.6	05.0	04.0	04.9	05.4	05.1	05.6	06.1
125	00.2	1499.1	1499.7	00.1	01.7	01.3	01.4	01.1
150	1496.0	95.7	95.9	1496.2	1496.2	1496.1	1496.4	1496.6
200	89.9	90.0	89.7	90.0	90.0	90.1	90.2	90.1
SC	6	6	11	28	11	11	11	23
DC	50	50	34	45	20	50	20	68
MAX	73	62	62	68	30	79	34	101
DC					51			
MAX					79			

Table A-2, continued.

Depth, m	0130	0140	0150	0200	0210	0220	0230	0240
0	1506.5	1506.5	1506.6	1506.6	1506.6	1506.5	1506.5	1506.5
10	06.6	06.8	06.8	06.8	06.8	06.9	06.6	06.7
20	06.9	06.9	06.9	06.9	06.9	06.7	06.9	06.5
30	06.9	07.1	07.1	07.0	06.9	06.9	06.5	06.5
50	06.3	06.4	06.4	06.7	06.4	06.4	06.6	06.5
75	06.3	06.5	06.3	06.5	06.4	06.4	06.5	06.5
100	06.4	05.8	05.5	05.1	05.2	05.7	05.7	04.1
125	01.4	01.9	00.6	00.5	1499.7	00.1	00.8	1499.0
150	1496.4	1497.1	1496.5	1496.5	96.9	1497.1	1497.5	95.8
200	90.4	90.3	90.0	90.4	91.0	90.1	90.4	90.3
SC	39	45	39	39	39	10	23	11
DC	51	51	51	62	51	20	28	
MAX	101	85	62	79	85	85	39	

Depth, m	0250	0300	0330	0400	0430	0530	0600	0644
0	1506.4	1506.5	1506.5	1506.7	1506.7	1506.4	1506.8	1507.0
10	06.5	06.7	06.8	06.9	06.8	06.6	07.0	07.1
20	06.5	06.6	06.8	06.6	06.5	06.5	07.1	07.2
30	06.5	06.6	06.6	06.3	06.1	06.4	06.3	06.9
50	06.5	06.7	06.3	06.3	06.4	06.3	06.5	07.2
75	06.5	06.5	06.2	06.5	06.8	06.4	06.2	06.9
100	04.6	04.9	04.6	05.8	05.7	05.8	05.9	06.7
125	1499.8	00.9	1499.6	01.8	03.1	03.2	04.1	04.0
150	96.9	1496.6	96.6	1497.5	1497.6	1497.2	1496.9	1499.7
200	90.8	90.8	90.9	90.4	91.0	91.6	91.4	92.1
SC	85	17	23	17	17	11	23	20
DC		25	56	34	34	45	34	37
MAX		50	96	73	85	90	50	56

Table A-3. Average Sound-Speed Profile (m/sec), Station 4 Run 1 (21-22 February 1972 2342-0647 LST).

Depth, m	Number of Observations	Average Speed	Standard Deviation
0	2421	1506.67	0.23
10	2421	06.79	0.19
20	2421	06.79	0.21
30	2421	06.69	0.33
50	2421	06.48	0.23
75	2421	06.44	0.27
100	2421	05.66	0.78
125	2421	01.94	1.72
150	2421	1497.16	0.95
200	2421	90.78	0.68
250	2421	88.03	0.53
300	12	86.01	0.32
400	11	83.02	0.45
500	9	81.81	0.29
600	5	81.36	0.36
800	4	81.25	0.15
1000	4	82.17	0.22
1200	4	83.47	0.22
1500	4	86.06	0.22
17		1506.87	SC
700		1481.20	AXIS

Table A-4. Average Thermistor Chain Temperatures, Station 4 Run 1 (number of measurements at each depth: 2421).

Depth	Temperature °C			Standard
m	Min	Max	Mean	Deviation
0	15.27	15.65	15.42	0.065
6	15.27	15.60	15.42	0.061
11	15.25	15.60	15.41	0.057
17	15.20	15.55	15.38	0.059
23	15.07	15.50	15.34	0.082
28	15.05	15.50	15.29	0.100
34	15.00	15.42	15.20	0.109
39	14.97	15.47	15.20	0.104
45	14.95	15.37	15.14	0.090
51	14.87	15.35	15.07	0.067
56	14.92	15.35	15.06	0.053
62	14.85	15.20	15.04	0.050
58	14.77	15.17	15.00	0.067
73	14.75	15.12	14.97	0.073
79	14.65	15.15	14.94	0.093
85	14.52	15.10	14.86	0.127
90	14.42	15.12	14.77	0.145
96	14.32	15.12	14.68	0.154
101	13.95	15.00	14.47	0.234
107	13.67	14.87	14.25	0.283
113	13.20	14.75	14.01	0.341
118	12.62	14.60	13.71	0.429
124	12.45	14.35	13.36	0.503
130	12.17	13.97	12.93	0.454
135	11.80	13.60	12.52	0.394
141	11.57	13.25	12.20	0.391
147	11.45	12.80	11.97	0.307
152	10.97	12.37	11.62	0.264
158	10.72	12.12	11.29	0.282
164	10.50	11.75	10.99	0.268
169	10.32	11.42	10.74	0.225
175	10.02	11.00	10.49	0.211
180	9.85	10.85	10.28	0.218
186	9.62	10.57	10.04	0.210
192	9.52	10.32	9.88	0.199
197	9.40	10.17	9.74	0.180
203	9.25	10.05	9.62	0.192
209	9.12	9.97	9.43	0.207
214	8.97	9.85	9.29	0.209
220	8.90	9.75	9.19	0.184
226	8.82	9.57	9.08	0.151
231	8.67	9.35	8.97	0.131
237	8.62	9.32	8.89	0.132
242	8.47	9.17	8.78	0.138

Table A-5. Standard Deviation (cm) of Wave Height for 3-Min Averages, Station 4 Run 1 (21-22 February 1972 2342-0647 LST).

	Hours							
Minutes	2300	0000	0100	0200	0300	0400	0500	0600
01		49	48	46	41	47	44	52
04		64	47	44	47	52	39	50
07		45	49	41	46	46	47	37
10		49	56	36	47	41	44	50
13		47	41	37	45	34	50	45
16		53	52	52	56	45	45	53
19		44	40	57	38	37	54	58
22		47	44	29	43	50	49	54
25		57	39	53	42	46	45	47
28		52	52	52	45	41	37	39
31		64	43	43	47	40	38	48
34		53	52	41	41	51	52	43
37		51	50	57	38	51	52	44
40		53	44	48	52	36	49	36
43	51	42	58	42	51	53	44	44
46	61	47	48	37	40	42	37	
49	49	51	44	44	44	59	52	
52	43	43	41	42	48	55	37	
55	56	40	39	42	42	33	48	
58	50	50	54	49	49	40	45	

Table A-6. Standard Deviation of Wave Height as a Function of Wave Period, Station 4 Run 1 (21-22 February 1972).

Wave-Period Band, sec	Standard Deviation, cm	Wave-Period Band, sec	Standard Deviation, cm
2342-0041 LST			
1.2 – 1.4	2.9	7.5 – 7.9	8.4
1.5 – 1.9	4.2	8.0 – 8.3	7.5
2.0 – 2.4	3.8	8.4 – 8.7	7.8
2.5 – 2.9	3.5	8.8 – 9.2	11.5
3.0 – 3.4	3.5	9.3 – 9.7	8.8
3.5 – 3.9	3.7	9.8 – 10.2	13.4
4.0 – 4.4	3.9	10.3 – 10.7	17.6
4.5 – 4.9	4.5	10.8 – 11.4	15.1
5.0 – 5.4	5.6	11.5 – 12.1	23.8
5.5 – 5.9	6.9	12.2 – 13.0	12.7
6.0 – 6.4	7.4	13.1 – 14.0	10.5
6.5 – 6.9	7.2	14.1 – 15.1	10.6
7.0 – 7.4	7.1	15.2 – 16.4	12.3
0042-0241 LST			
1.2 – 1.4	2.5	7.5 – 7.9	9.1
1.5 – 1.9	3.3	8.0 – 8.3	7.8
2.0 – 2.4	3.3	8.4 – 8.7	8.8
2.5 – 2.9	3.2	8.8 – 9.2	8.9
3.0 – 3.4	3.3	9.3 – 9.7	11.2
3.5 – 3.9	3.7	9.8 – 10.2	12.8
4.0 – 4.4	3.9	10.3 – 10.7	12.8
4.5 – 4.9	4.4	10.8 – 11.4	16.9
5.0 – 5.4	5.8	11.5 – 12.1	16.8
5.5 – 5.9	6.9	12.2 – 13.0	10.9
6.0 – 6.4	6.6	13.1 – 14.0	10.1
6.5 – 6.9	6.2	14.1 – 15.1	10.2
7.0 – 7.4	6.8	15.2 – 16.4	11.6
0242 – 0641 LST			
1.2 – 1.4	1.9	7.5 – 7.9	8.2
1.5 – 1.9	2.7	8.0 – 8.3	6.8
2.0 – 2.4	2.9	8.4 – 8.7	8.0
2.5 – 2.9	2.8	8.8 – 9.2	7.9
3.0 – 3.4	3.2	9.3 – 9.7	9.7
3.5 – 3.9	3.3	9.8 – 10.2	10.7
4.0 – 4.4	3.7	10.3 – 10.7	12.8
4.5 – 4.9	3.9	10.8 – 11.4	16.1
5.0 – 5.4	5.5	11.5 – 12.1	18.4
5.5 – 5.9	6.4	12.2 – 13.0	12.9
6.0 – 6.4	5.4	13.1 – 14.0	9.9
6.5 – 6.9	5.9	14.1 – 15.1	12.6
7.0 – 7.4	6.1	15.2 – 16.4	11.3

APPENDIX B

STATION 4 RUN 2

DETAILED ENVIRONMENTAL SUMMARY

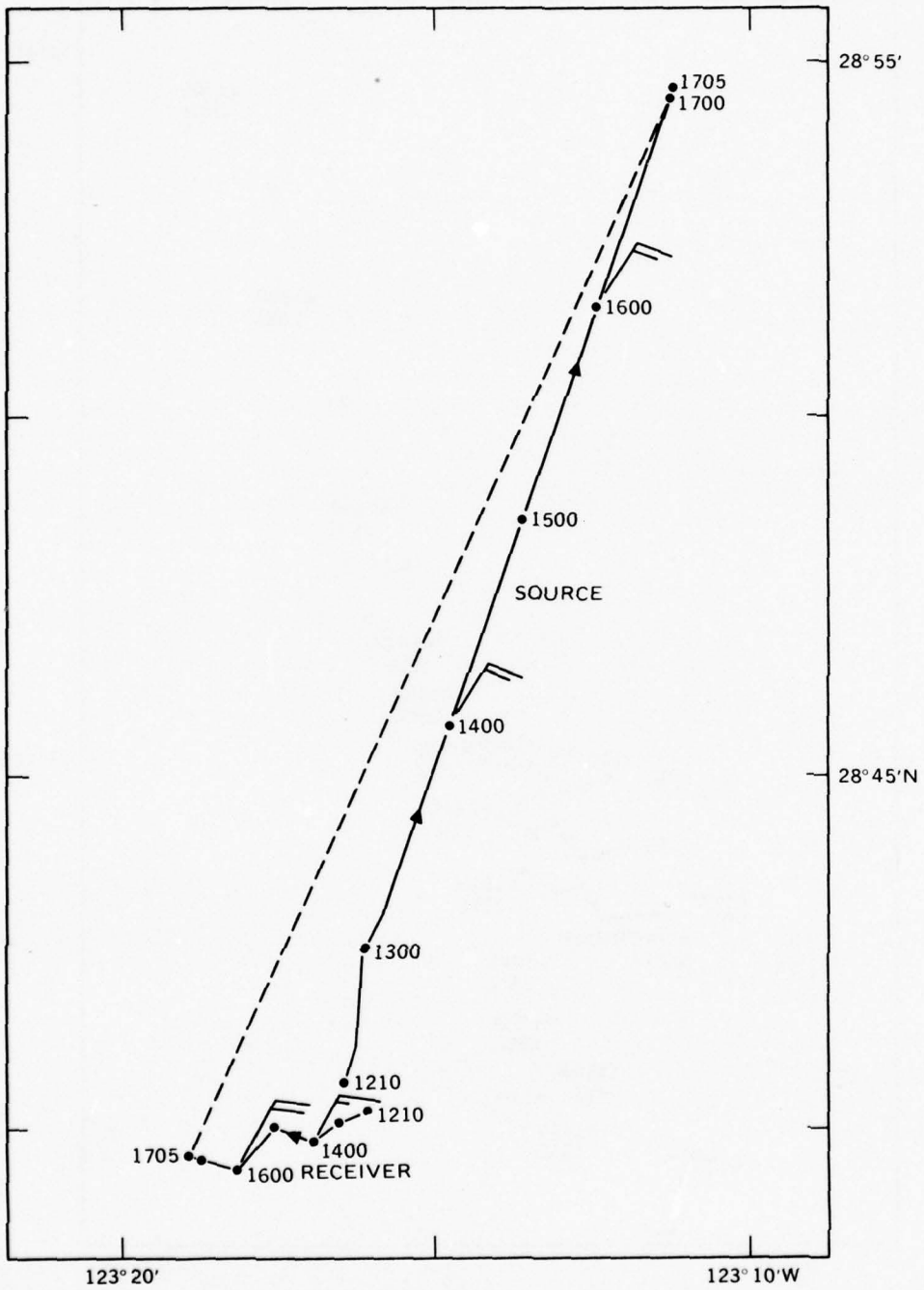

Figure B-1. Station 4, run 2. Location of source and receiver ships, 1705 LST propagation path (---), and wind velocity (10-knot east wind, 1 bar = 5 knots).

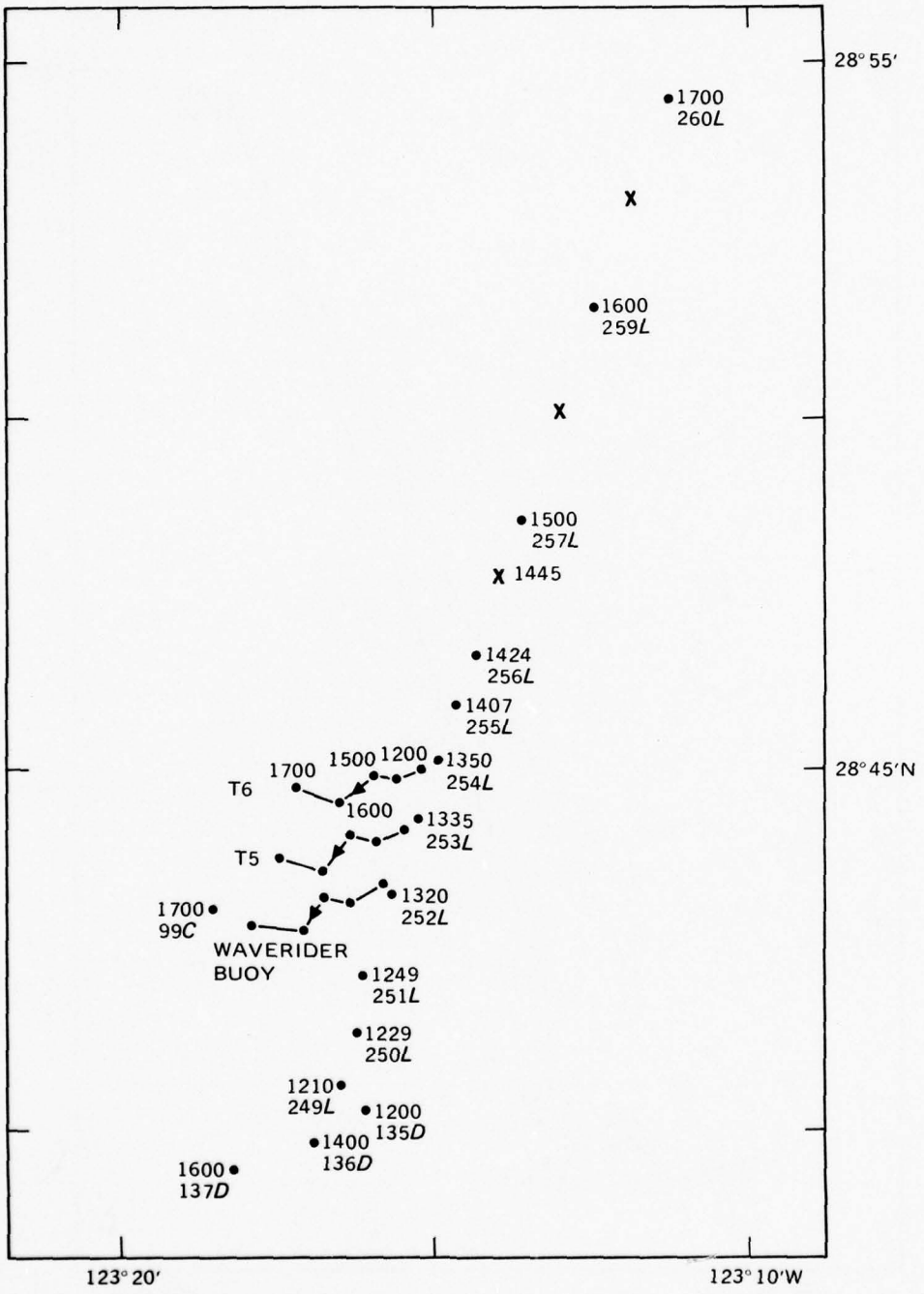

Figure B-2. Station 4, run 2. Location of XBT (·), thermistor chain (X), Teletherm buoy (T), and Waverider buoy measurements. Letter following XBT number denotes the ship which took the measurement (*L:Lee, D:DeSteiguer, C:Cape*). The times shown are LST.

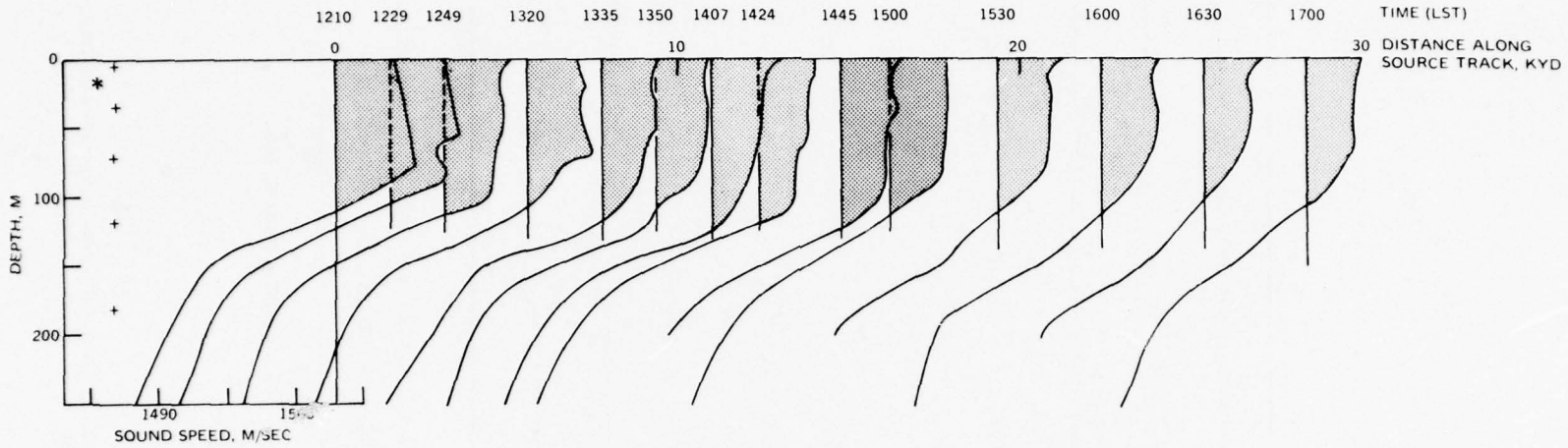

Figure B-3. Station 4, run 2. Sound speed profiles along track of source ship derived from XBT and thermistor chain data. Source depth (*), receiver depth (+).

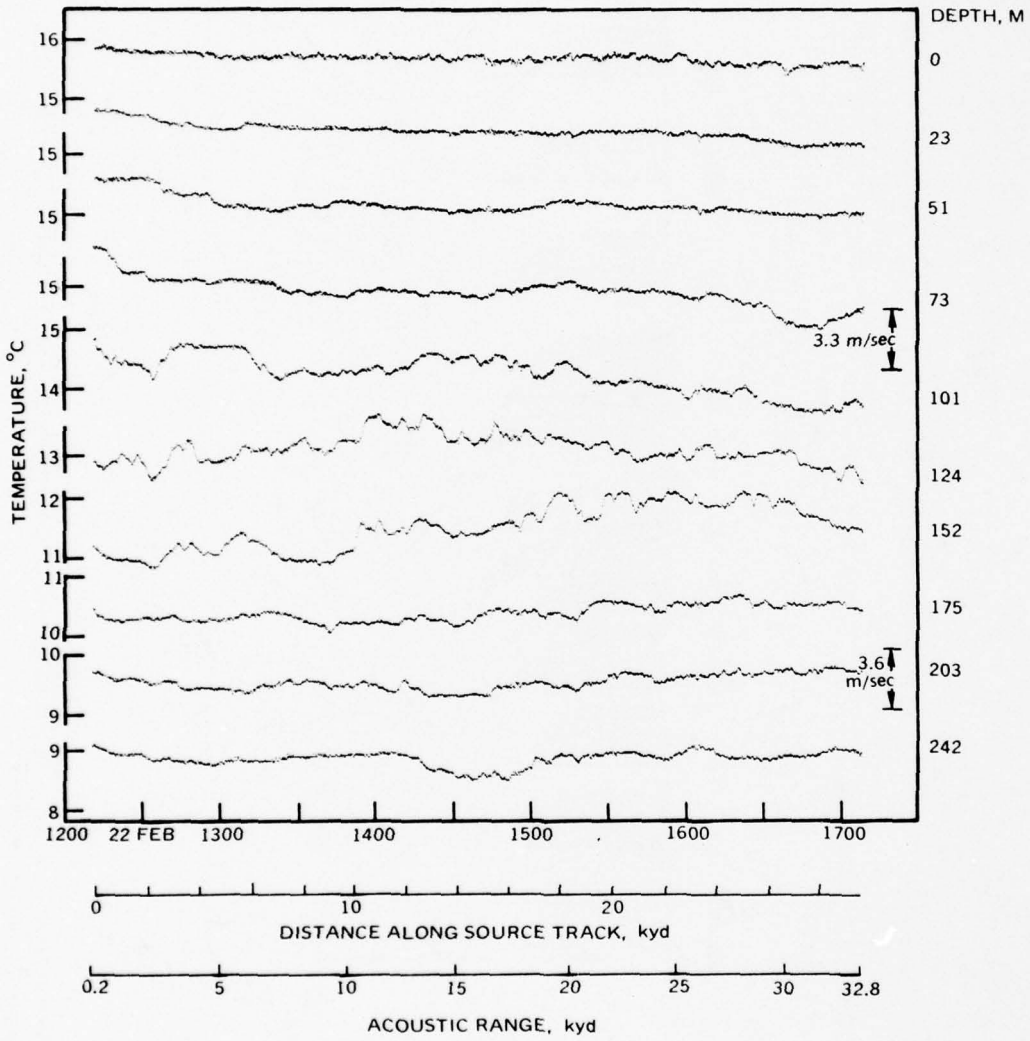

Figure B-4. Station 4, run 2. Thermistor chain temperature measurements at selected depths. Time is LST.

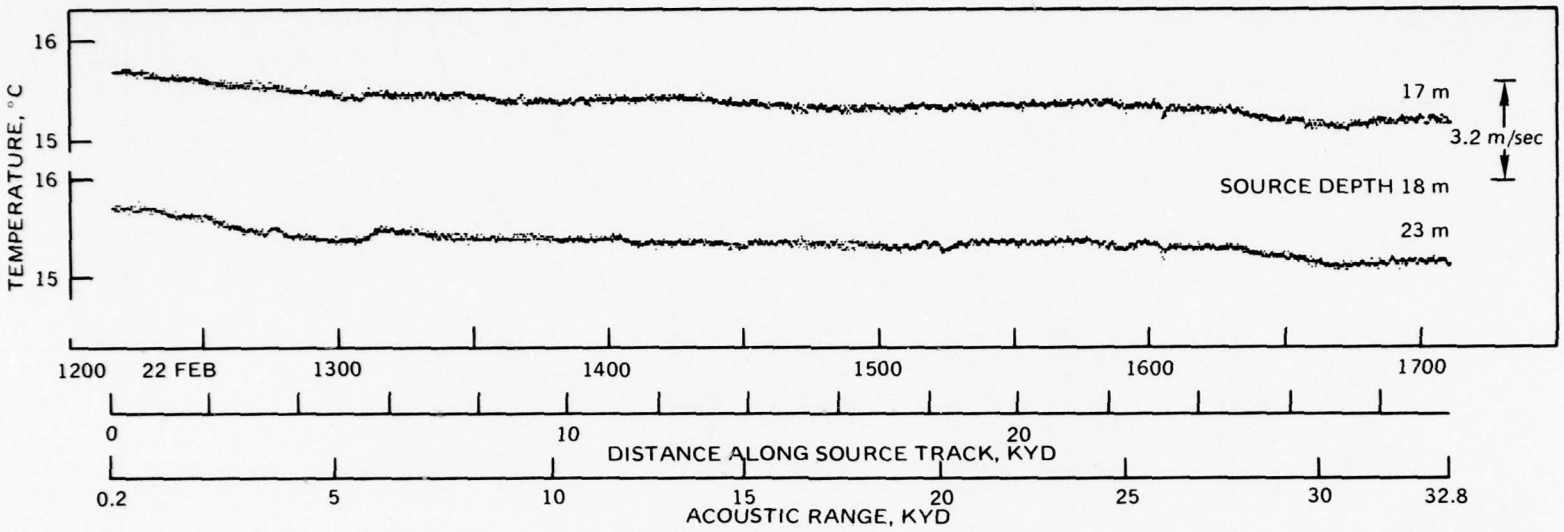

Figure B-5. Station 4, run 2. Temperatures above and below source. Time is LST.

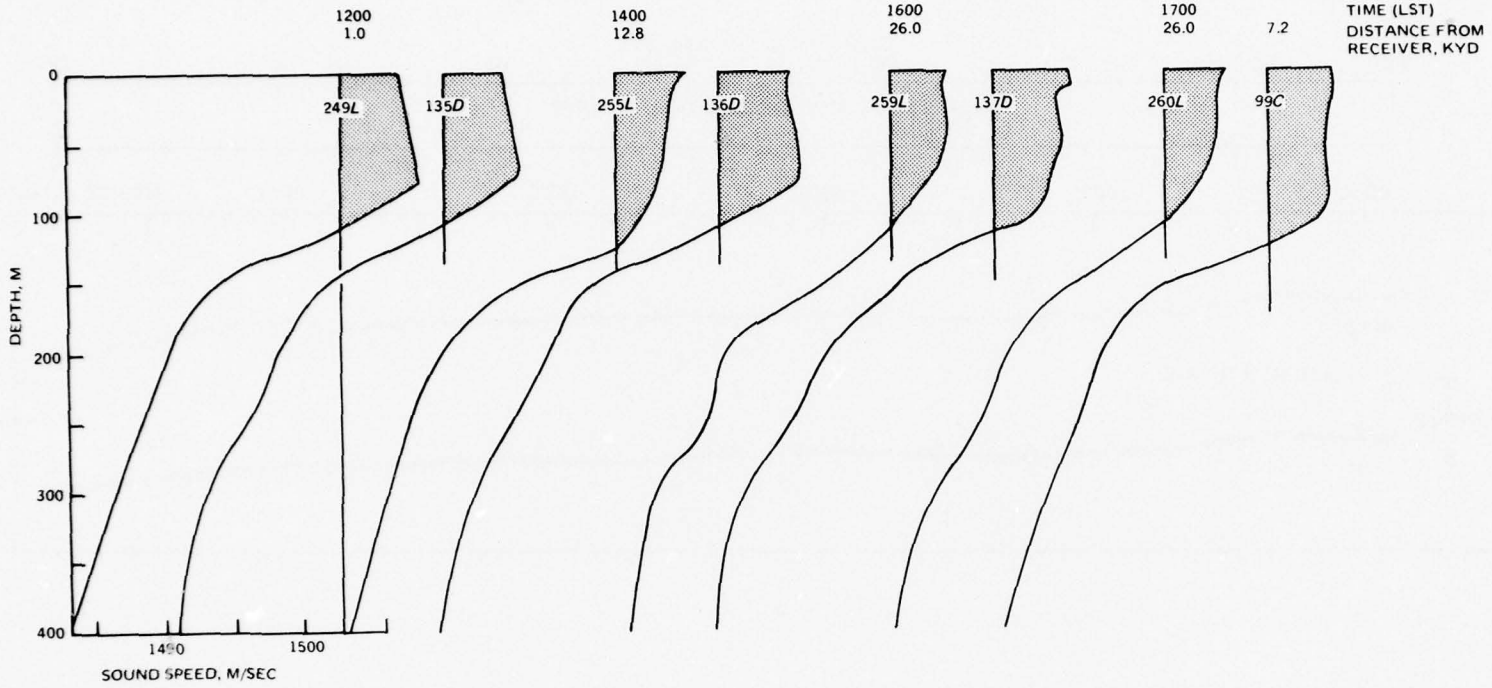

Figure B-6. Station 4, run 2. Spatial change in sound-speed profile.

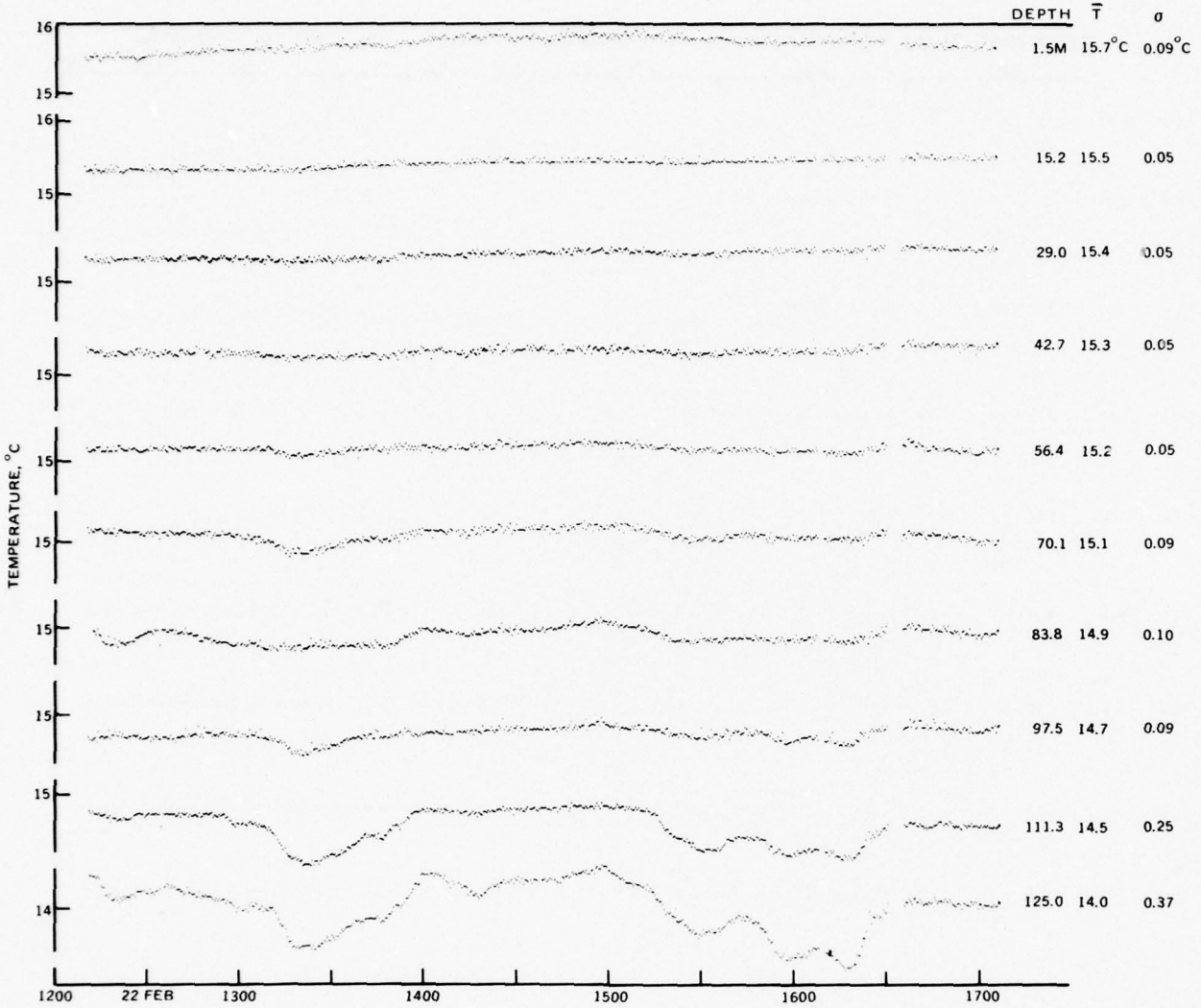

Figure B-7a. Station 4, run 2. Teletherm buoy 5 temperature measurements (n = 1608). Time is LST.

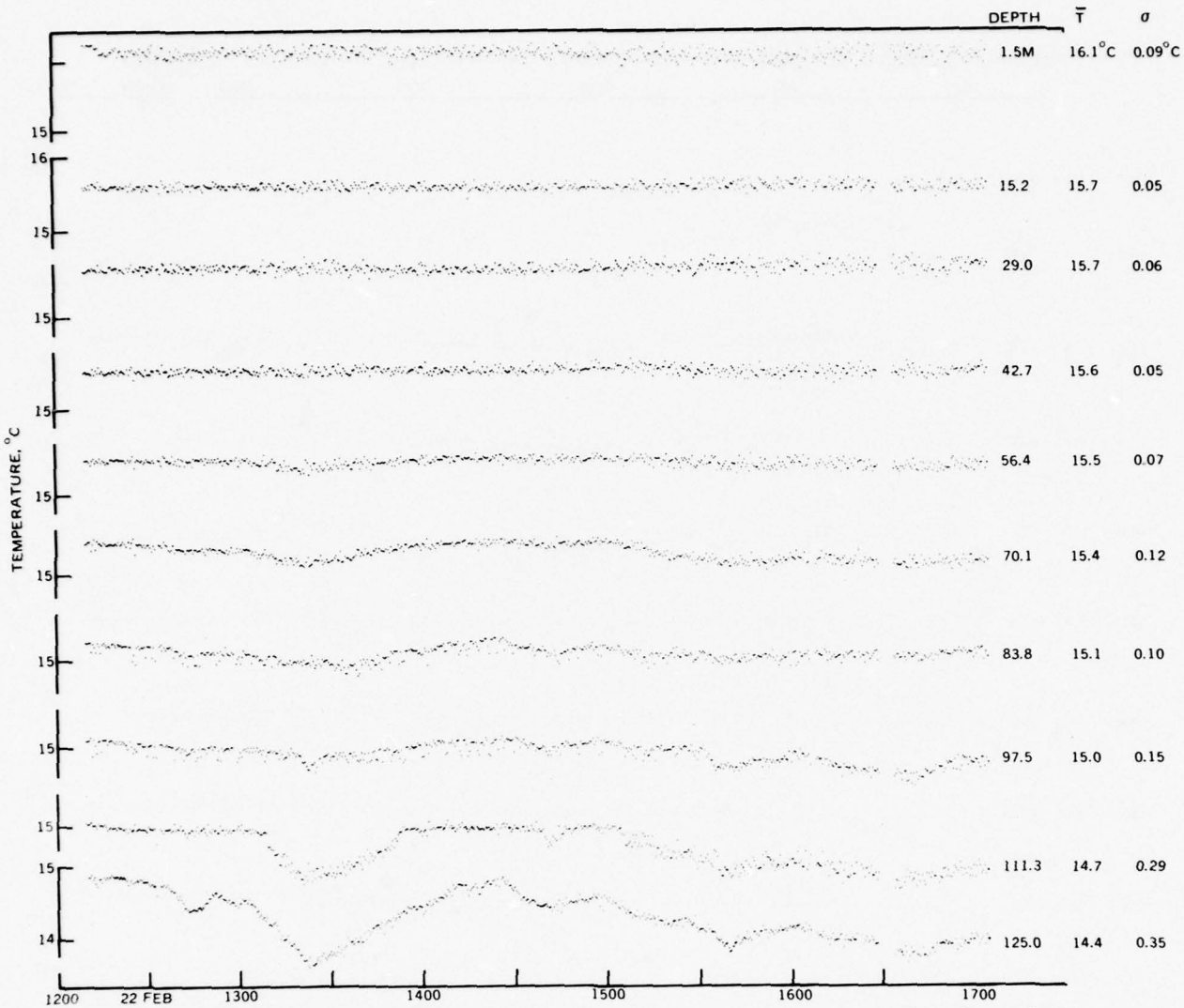

Figure B-7b. Station 4, run 2. Teletherm buoy 6 temperature measurements (n = 1571). Time is LST.

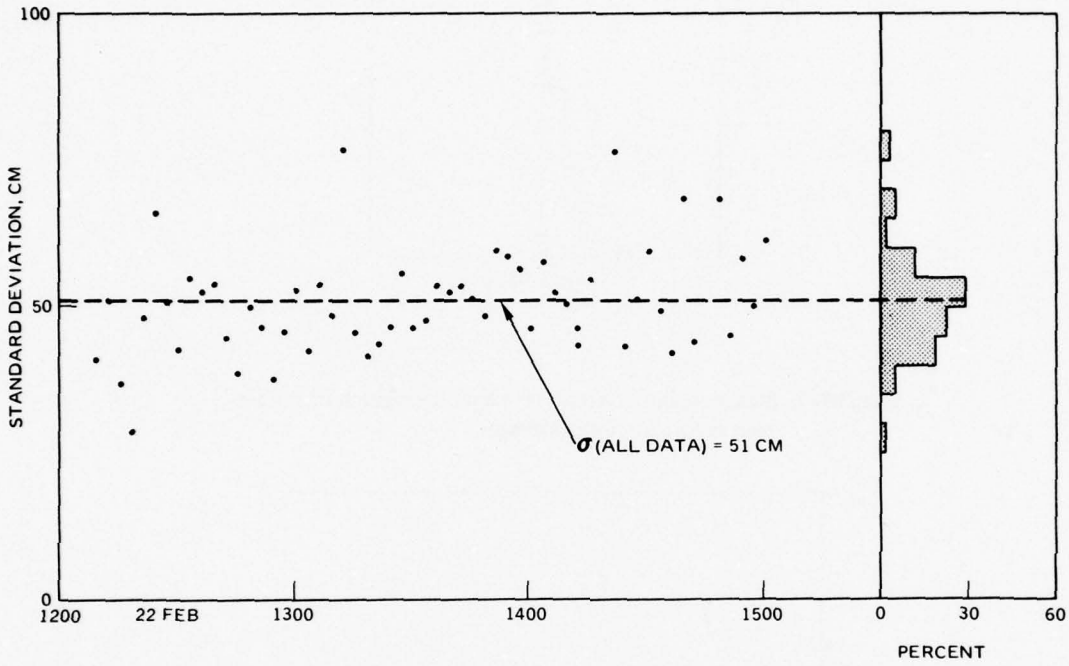

Figure B-8. Station 4, run 2. Standard deviation of surface-wave height for 3-min averages. Time is LST.

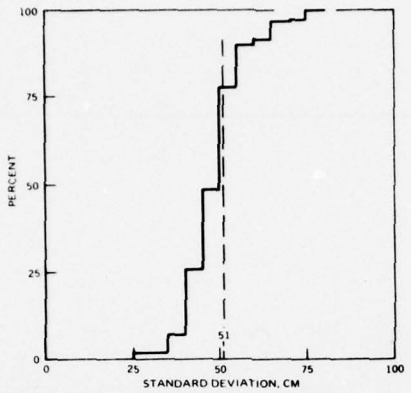

Figure B-9. Station 4, run 2. Ogive of standard deviation of surface-wave height for 3-min averages.

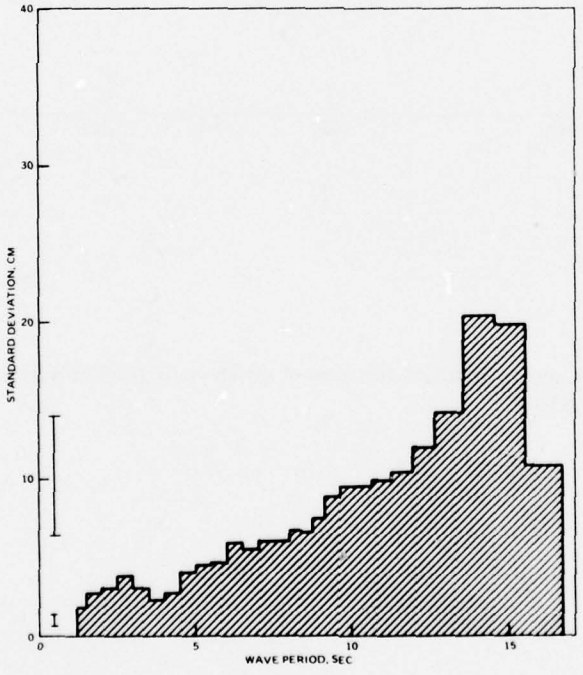

Figure B-10a. Station 4, run 2. Standard deviation of wave height as a function of wave period (22 February 1972, 1214-1309 LST).

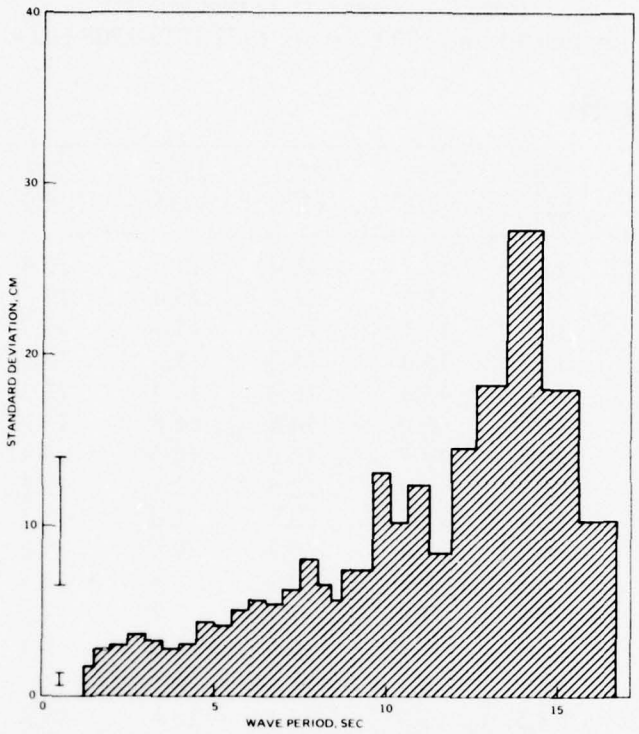

Figure B-10b. Station 4, run 2. Standard deviation of wave height as a function of wave period (22 February 1972, 1310-1405 LST).

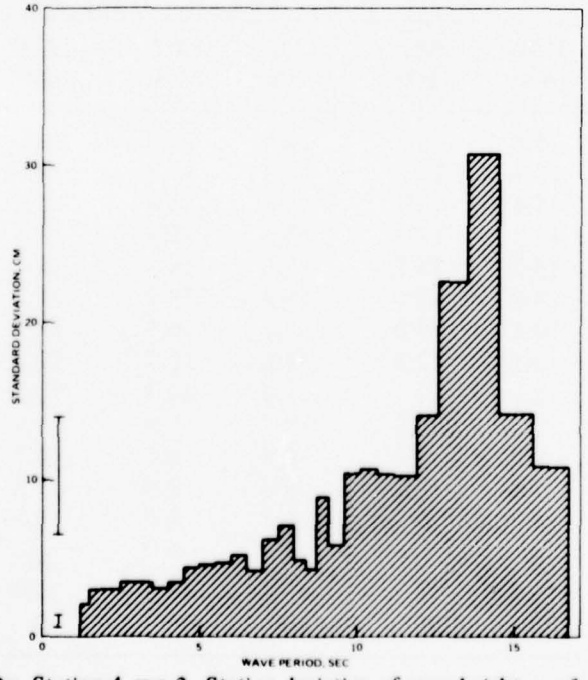

Figure B-10c. Station 4, run 2. Station deviation of wave height as a function of wave period (22 February 1972, 1406-1501 LST).

Table B-1. Temperature Profiles (°C),
Station 4 Run 2 (22 February 1972 1210-1705 LST).

XBT MEASUREMENTS

Depth, m	249L 1210	250L 1229	251L 1249	252L 1320	253L 1335	254L 1350	255L 1407	256L 1424
0	15.6	15.5	15.7	15.4	15.6	15.4	15.9	15.5
10	15.6	15.5	15.5	15.4	15.4	15.3	15.5	15.4
20	15.6	15.5	15.4	15.5	15.3	15.2	15.4	15.3
30	15.6	15.5	15.4	15.3	15.3	15.2	15.3	15.2
50	15.6	15.5	15.3	15.0	15.2	15.1	15.1	15.1
75	15.6	15.0	15.0	14.8	14.8	14.9	14.9	14.7
100	14.4	14.1	14.7	14.0	14.3	14.1	14.4	14.5
125	12.6	12.3	12.6	12.6	13.1	13.1	13.6	13.1
150	10.8	10.7	11.1	10.8	11.0	11.2	11.4	11.3
200	9.6	9.3	9.4	9.3	9.6	9.3	9.5	9.2
250	8.7	8.5	8.7	8.5	8.4	8.5	8.6	8.3
300	7.9	7.5	7.9	7.7	7.9	7.7	7.9	7.7
400	6.6	6.4	6.7	6.6	6.6	6.5	6.7	6.5
ILD	77	55	0	20	0	0	0	0
T	15.6	15.5	15.7	15.4	15.6	15.4	15.9	15.5
SLD	77	88	92	70	85	90	87	110

Depth, m	257L 1500	259L 1600	260L 1700	135D 1200	136D 1400	137D 1600	99C 1300
0	15.6	15.6	15.7	15.6	15.9	16.0	15.4
10	15.5	15.4	15.4	15.6	15.8	16.0	15.3
20	15.5	15.4	15.3	15.6	15.8	15.6	15.3
30	15.4	15.4	15.2	15.6	15.8	15.6	15.1
50	15.3	15.3	15.1	15.6	15.8	15.6	14.9
75	15.1	14.9	14.7	15.5	15.7	15.2	14.7
100	14.3	14.1	14.0	14.1	14.3	14.7	14.2
125	13.1	13.1	12.8	12.5	12.7	12.8	12.6
150	11.7	12.1	11.7	11.0	10.9	11.5	10.8
200	9.7	9.7	9.9	9.7	9.6	9.7	9.3
250	8.8	9.0	9.0	8.8	8.6	8.7	8.4
300	7.7	7.8	7.9	8.0	7.9	7.8	7.5
400	6.6	6.7	6.6	6.7	6.5	6.5	6.4
ILD	0	0	0	70	5	10	0
T	15.6	15.6	15.7	15.6	15.9	16.0	15.4
SLD	90	50	60	70	76	90	85

Table B-1, continued.

THERMISTOR CHAIN MEASUREMENTS

Depth, m	1445	1530	1630
0	15.6	15.8	15.6
10	15.4	15.3	15.2
20	15.3	15.4	15.2
30	15.3	15.3	15.2
50	15.0	15.1	15.0
75	14.9	14.9	14.6
100	14.6	14.2	13.8
125	13.4	13.0	13.0
150	11.7	12.1	12.1
200	9.5	9.7	9.7
ILD	0	0	0
T	15.6	15.8	15.6
SLD	90	79	62

Table B-2. Computed Sound-Speed Profiles (m/sec), Station 4 Run 2 (22 February 1972 1210-1705 LST).

XBT MEASUREMENTS

Depth, m	249L 1210	250L 1229	251L 1249	252L 1320	253L 1335	254L 1350	255L 1407	256L 1424
0	1507.2	1506.9	1507.6	1506.6	1507.2	1506.6	1508.2	1506.9
10	07.4	07.1	07.1	06.8	06.8	06.4	07.1	06.8
20	07.6	07.2	06.9	07.2	06.6	06.3	06.9	06.6
30	07.7	07.4	07.1	06.8	06.8	06.5	06.8	06.5
50	08.1	07.8	07.1	07.2	06.8	06.5	06.5	06.5
75	08.6	06.6	06.6	05.9	05.9	06.2	06.2	05.6
100	05.1	04.1	06.1	03.8	04.8	04.1	05.1	05.5
125	1499.5	1498.5	1499.5	1499.5	01.3	01.3	03.0	01.3
150	93.7	93.4	94.8	93.7	1494.4	1495.1	1495.8	1495.5
200	90.5	89.4	89.8	89.4	90.5	89.4	90.1	89.1
250	88.2	87.5	88.2	87.5	87.1	87.5	87.8	86.7
300	86.2	84.6	86.2	85.4	86.2	85.4	86.2	85.4
400	82.9	82.0	83.3	82.9	82.9	82.4	83.3	82.4
SC	77	55	0	20	0	0	0	0
DC		64	25	35	20	20		
MAX		88	52	70	50	50		

Depth, m	257L 1500	259L 1600	260L 1700	135D 1200	136D 1400	137D 1600	99C 1300
0	1507.2	1507.2	1507.6	1507.2	1508.2	1508.5	1507.6
10	07.1	06.8	06.8	07.4	08.0	08.7	07.7
20	07.2	06.9	06.6	07.6	08.2	07.6	07.6
30	07.1	07.1	06.5	07.7	08.4	07.7	07.4
50	07.1	07.1	06.5	08.1	08.7	08.1	07.1
75	06.9	06.2	05.6	08.2	08.9	07.2	07.2
100	04.8	04.1	03.8	04.1	04.8	06.1	07.1
125	01.3	01.3	00.2	1499.2	1499.9	00.2	02.6
150	1496.9	1498.3	1496.9	94.4	94.1	1496.2	1496.5
200	90.8	90.8	91.6	90.8	90.5	90.8	90.8
250	88.6	89.4	89.4	88.6	87.8	88.2	89.0
300	85.4	85.8	86.2	85.4	85.0	84.6	86.9
400	82.9	83.3	82.9	83.3	82.4	82.4	83.3
SC	0	0	0	70	5	10	10
DC	10	5			10	13	50
MAX	20	50			76	50	90

Table B-2, continued.

THERMISTOR CHAIN MEASUREMENTS

Depth, m	1445	1530	1630
0	1507.3	1507.8	1507.3
10	06.6	06.6	06.2
20	06.7	06.8	06.2
30	06.8	06.7	06.4
50	06.3	06.6	06.2
75	06.2	06.3	05.2
100	05.7	04.3	03.2
125	02.2	01.0	00.8
150	1496.8	1498.4	1498.4
200	90.3	91.0	91.0
SC	0	0	0
DC	10	10	15
MAX	35	20	30

Table B-3. Average Sound-Speed Profile (m/sec), Station 4 Run 2 (22 February 1972 1210-1705 LST).

Depth, m	Number of Observations	Average Speed	Standard Deviation
0	1782	1507.40	0.22
10	1782	06.89	0.39
20	1782	06.83	0.39
30	1782	06.78	0.42
50	1782	06.64	0.49
75	1782	06.11	0.80
100	1782	04.79	1.02
125	1782	01.08	0.83
150	1782	1496.75	1.37
200	1782	90.46	0.92
250	1782	88.41	0.49
300	20	85.79	0.54
400	20	82.78	0.41
500	9	81.81	0.29
600	5	81.36	0.36
800	4	81.25	0.15
1000	4	82.17	0.22
1200	4	83.47	0.22
1500	4	86.06	0.22
700		1480.20	AXIS

Table B-4. Average Thermistor Chain Temperatures, Station 4 Run 2 (number of measurements at each depth: 1782).

Depth, m	Temperature, °C			Standard Deviation
	Min	Max	Mean	
0	15.37	15.87	15.65	0.074
6	15.15	15.75	15.45	0.110
11	15.12	15.75	15.41	0.120
17	15.10	15.70	15.38	0.119
23	15.07	15.75	15.35	0.121
28	15.02	15.70	15.32	0.127
34	14.92	15.70	15.25	0.135
39	14.95	15.70	15.24	0.148
45	14.95	15.67	15.20	0.156
51	14.87	15.60	15.13	0.152
56	14.72	15.70	15.12	0.173
62	14.52	15.65	15.04	0.197
68	14.35	15.60	14.89	0.201
73	14.22	15.70	14.88	0.233
79	14.15	15.65	14.82	0.254
85	14.02	15.37	14.71	0.266
90	13.80	15.15	14.58	0.308
96	13.72	15.10	14.46	0.328
101	13.55	14.80	14.22	0.302
107	13.35	14.47	14.01	0.274
113	13.00	14.42	13.77	0.284
118	12.77	14.12	13.42	0.267
124	12.47	13.67	13.08	0.236
130	12.20	13.40	12.79	0.218
135	11.75	13.10	12.49	0.229
141	11.52	12.60	12.17	0.286
147	11.07	12.45	11.86	0.364
152	10.75	12.15	11.48	0.397
158	10.57	11.77	11.14	0.306
164	10.40	11.42	10.82	0.245
169	10.27	11.00	10.56	0.180
175	10.00	10.70	10.36	0.150
180	9.82	10.52	10.17	0.157
186	9.70	10.42	9.96	0.153
192	9.60	10.25	9.82	0.138
197	9.32	10.10	9.65	0.127
203	9.22	9.82	9.52	0.139
209	9.15	9.67	9.39	0.138
214	9.05	9.62	9.30	0.130
220	9.02	9.57	9.21	0.104
226	8.92	9.37	9.11	0.081
231	8.82	9.22	9.02	0.073
237	8.62	9.20	8.95	0.107
242	8.47	9.10	8.85	0.127

Table B-5. Standard Deviation (cm) of Wave Height for 3-Min Averages, Station 4 Run 2 (22 February 1972 1210-1705 LST).

	Hours			
Minutes	1200	1300	1400	1500
01		52	46	61
04		42	57	
07		53	52	
10	40	48	50	
13	50	76	43	
16	36	45	54	
19	28	41	44	
22	47	43	76	
25	65	46	43	
28	50	55	51	
31	42	46	59	
34	54	47	49	
37	52	53	42	
40	53	52	68	
43	44	53	44	
46	38	51	51	
49	49	48	68	
52	46	59	45	
55	37	58	58	
58	45	56	50	

Table B-6. Standard Deviation of Wave Height as a Function of Wave Period, Station 4 Run 2 (22 February 1972).

Wave-Period Band, sec	Standard Deviation, cm	Wave-Period Band, sec	Standard Deviation, cm
1214-1309 LST			
1.2 – 1.4	1.8	8.0 – 8.3	6.7
1.5 – 1.9	2.7	8.4 – 8.6	6.6
2.0 – 2.4	3.0	8.7 – 9.0	7.5
2.5 – 2.9	3.8	9.1 – 9.5	8.8
3.0 – 3.4	3.0	9.6 – 10.0	9.5
3.5 – 3.9	2.3	10.1 – 10.5	9.5
4.0 – 4.4	2.7	10.6 – 11.1	9.9
4.5 – 4.9	4.0	11.2 – 11.8	10.4
5.0 – 5.4	4.5	11.9 – 12.5	12.0
5.5 – 5.9	4.6	12.6 – 13.4	14.3
6.0 – 6.4	5.9	13.5 – 14.4	20.4
6.5 – 6.9	5.5	14.5 – 15.5	19.8
7.0 – 7.4	6.0	15.6 – 16.7	10.9
7.5 – 7.9	6.0		
1310-1405 LST			
1.2 – 1.4	1.8	8.0 – 8.3	6.6
1.5 – 1.9	2.8	8.4 – 8.6	5.7
2.0 – 2.4	3.0	8.7 – 9.0	7.5
2.5 – 2.9	3.7	9.1 – 9.5	7.5
3.0 – 3.4	3.3	9.6 – 10.0	13.1
3.5 – 3.9	2.8	10.1 – 10.5	10.2
4.0 – 4.4	3.1	10.6 – 11.1	12.4
4.5 – 4.9	4.4	11.2 – 11.8	8.4
5.0 – 5.4	4.2	11.9 – 12.5	14.6
5.5 – 5.9	5.1	12.6 – 13.4	18.3
6.0 – 6.4	5.7	13.5 – 14.4	27.3
6.5 – 6.9	5.5	14.5 – 15.5	18.0
7.0 – 7.4	6.3	15.6 – 16.7	10.3
7.5 – 7.9	8.1		

Table B-6, continued.

1406-1501 LST			
1.2 – 1.4	2.1	8.0 – 8.3	5.9
1.5 – 1.9	3.0	8.4 – 8.6	5.3
2.0 – 2.4	3.0	8.7 – 9.0	8.9
2.5 – 2.9	3.5	9.1 – 9.5	5.8
3.0 – 3.4	3.5	9.6 – 10.0	10.4
3.5 – 3.9	3.1	10.1 – 10.5	10.7
4.0 – 4.4	3.5	10.6 – 11.1	10.4
4.5 – 4.9	4.4	11.2 – 11.8	10.3
5.0 – 5.4	4.6	11.9 – 12.5	14.1
5.5 – 5.9	4.7	12.6 – 13.4	22.6
6.0 – 6.4	5.2	13.5 – 14.4	30.8
6.5 – 6.9	4.2	14.5 – 15.5	14.2
7.0 – 7.4	6.2	15.6 – 16.7	10.9
7.5 – 7.9	7.1		

APPENDIX C

STATION 4 RUN 3

DETAILED ENVIRONMENTAL SUMMARY

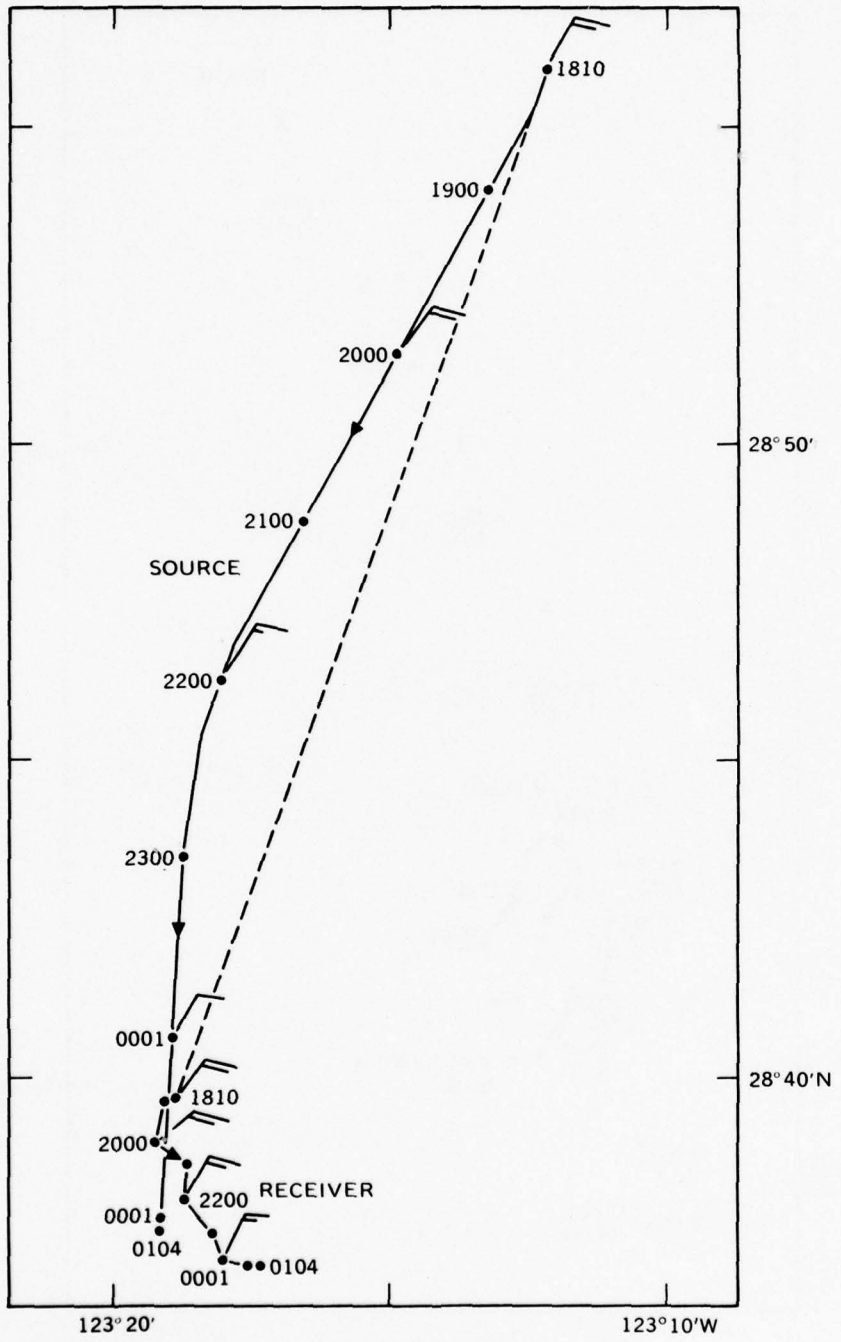

Figure C-1. Station 4, run 3. Location of source and receiver ships, 1810 LST propagation path (---), and wind velocity (10-knot east wind, 1 bar = 5 knots).

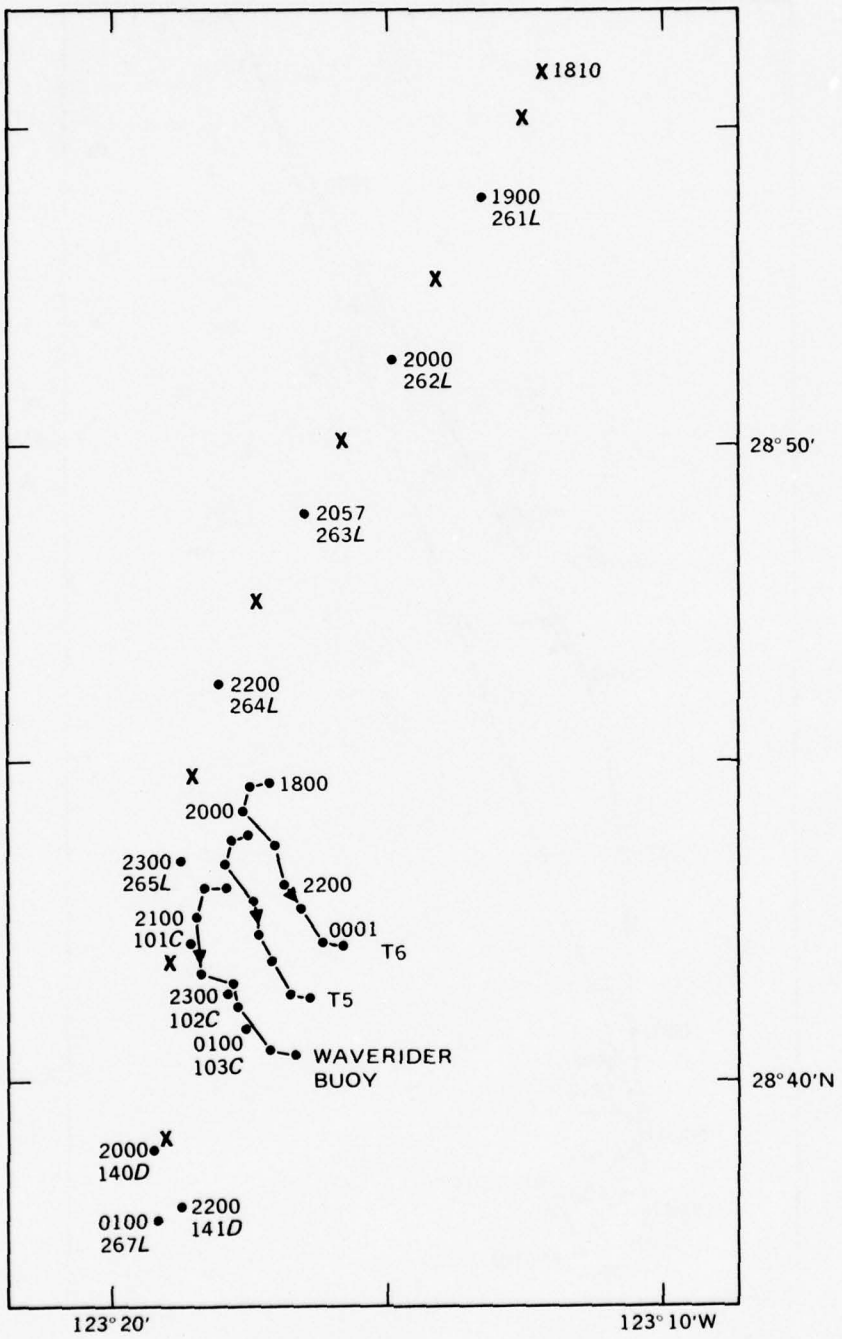

Figure C-2. Station 4, run 3. Location of XBT (·), thermistor chain (X), Teletherm buoy (T), and Waverider buoy measurements. Letter following XBT number denotes the ship which took the measurement (*L:Lee, C:Cape*). Times shown are LST.

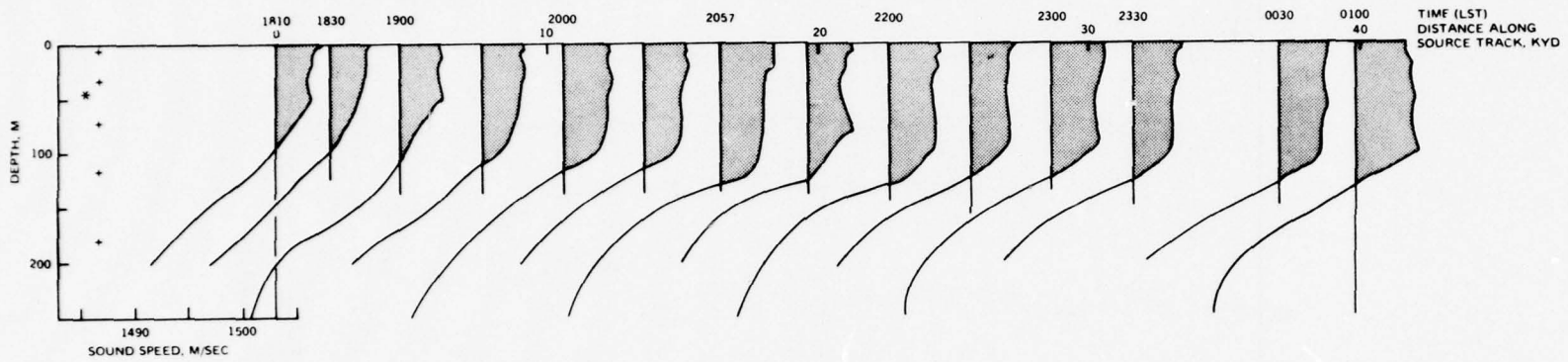

Figure C-3. Station 4, run 3. Sound-speed profiles along track of source ship derived from XBT and thermistor chain data. Source depth (*), receiver depths (+).

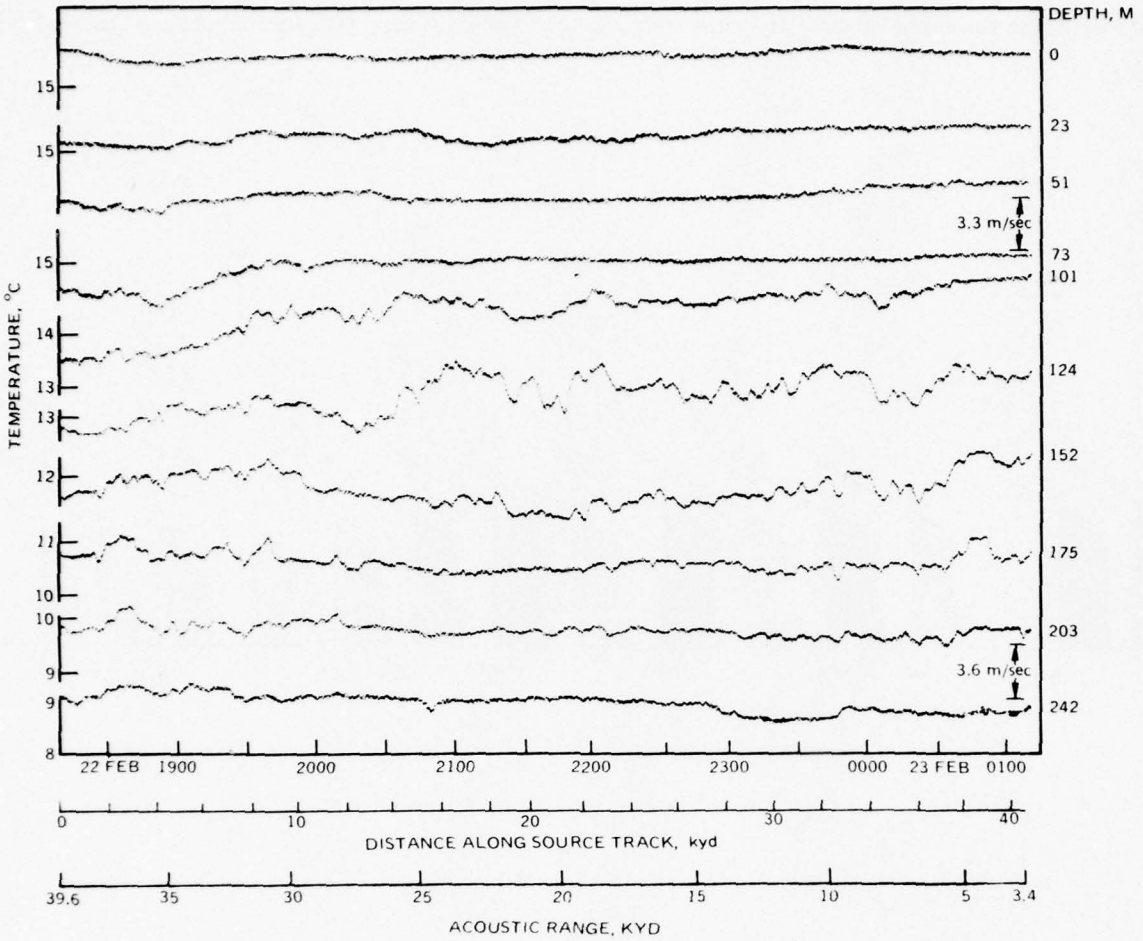

Figure C-4. Station 4, run 3. Thermistor chain temperature measurements at selected depths. Time is LST.

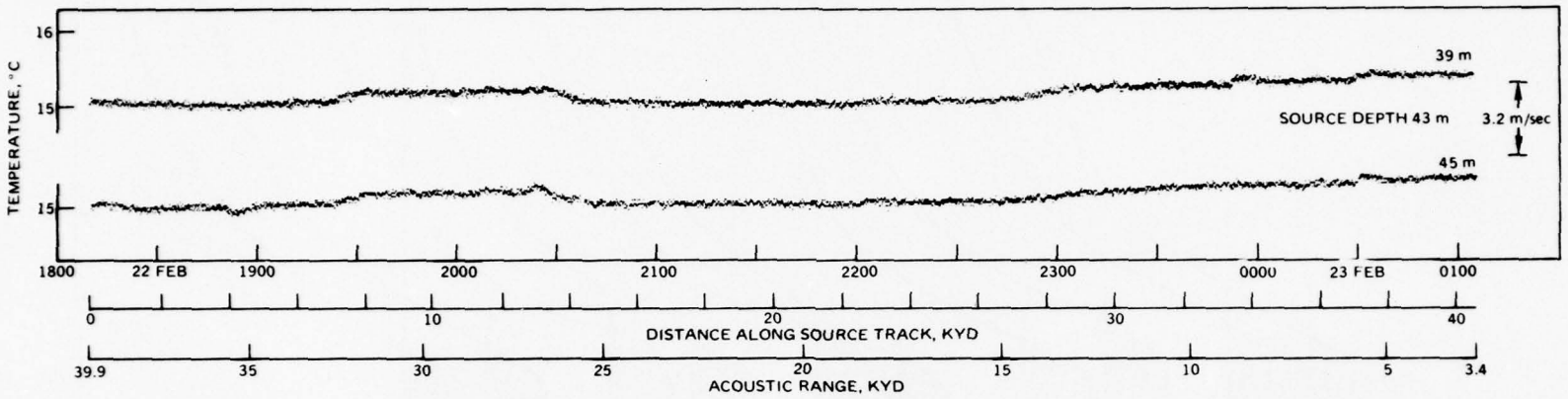

Figure C-5. Station 4, run 3. Temperatures above and below source. Time is LST.

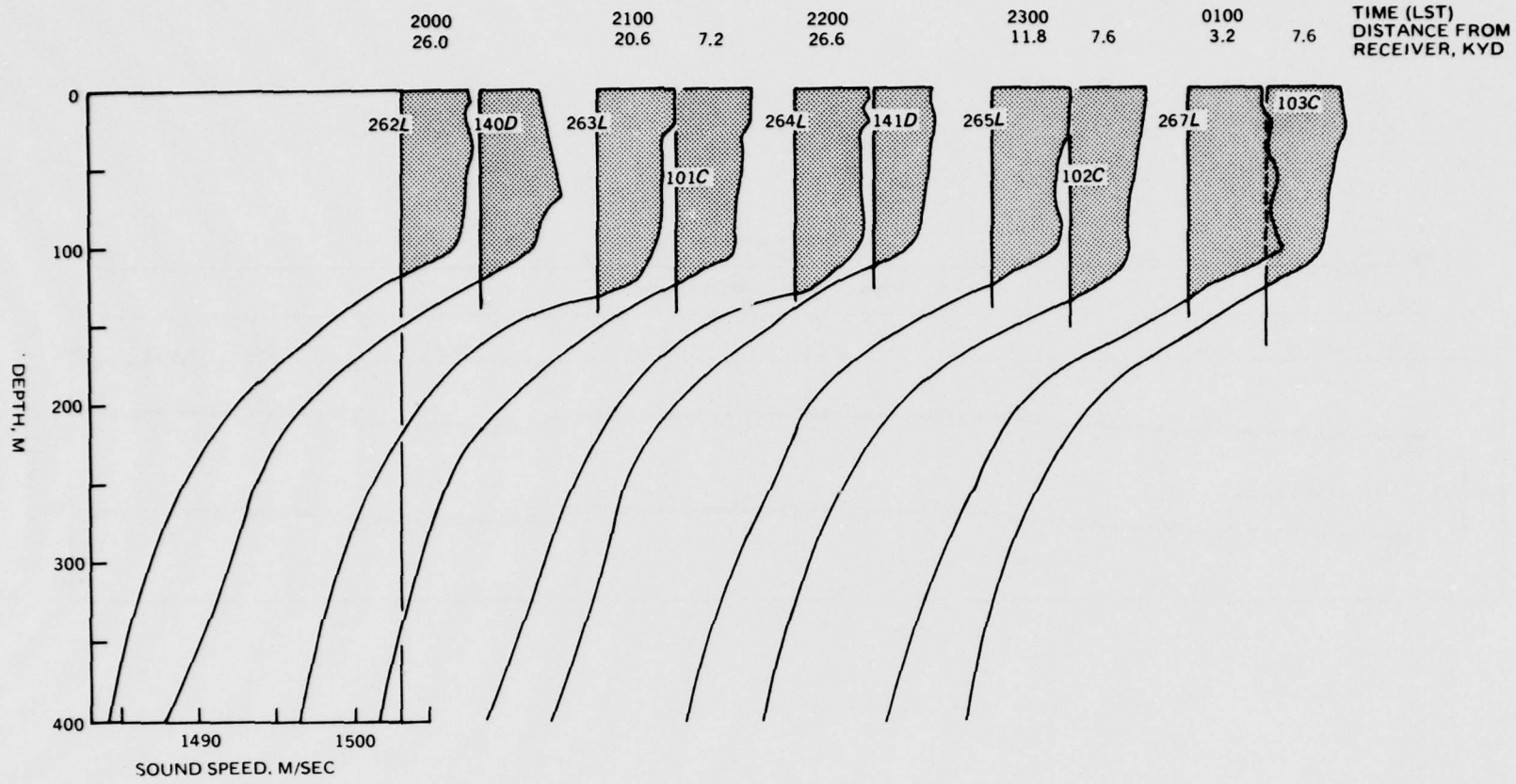

Figure C-6. Station 4, run 3. Spatial change in sound-speed profiles.

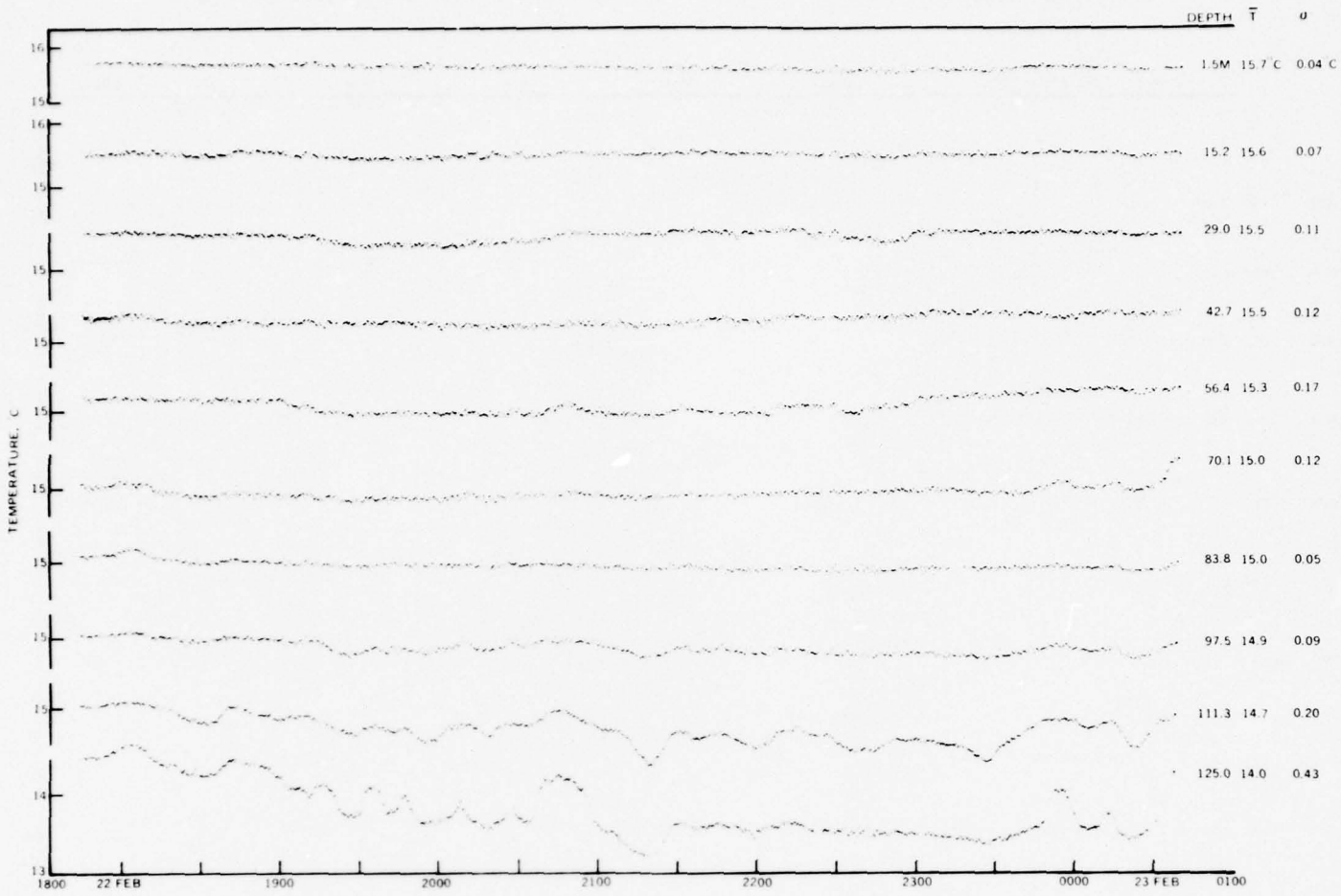

Figure C-7a. Station 4, run 3. Teletherm buoy 5 temperature measurements (n = 2279). Time is LST.

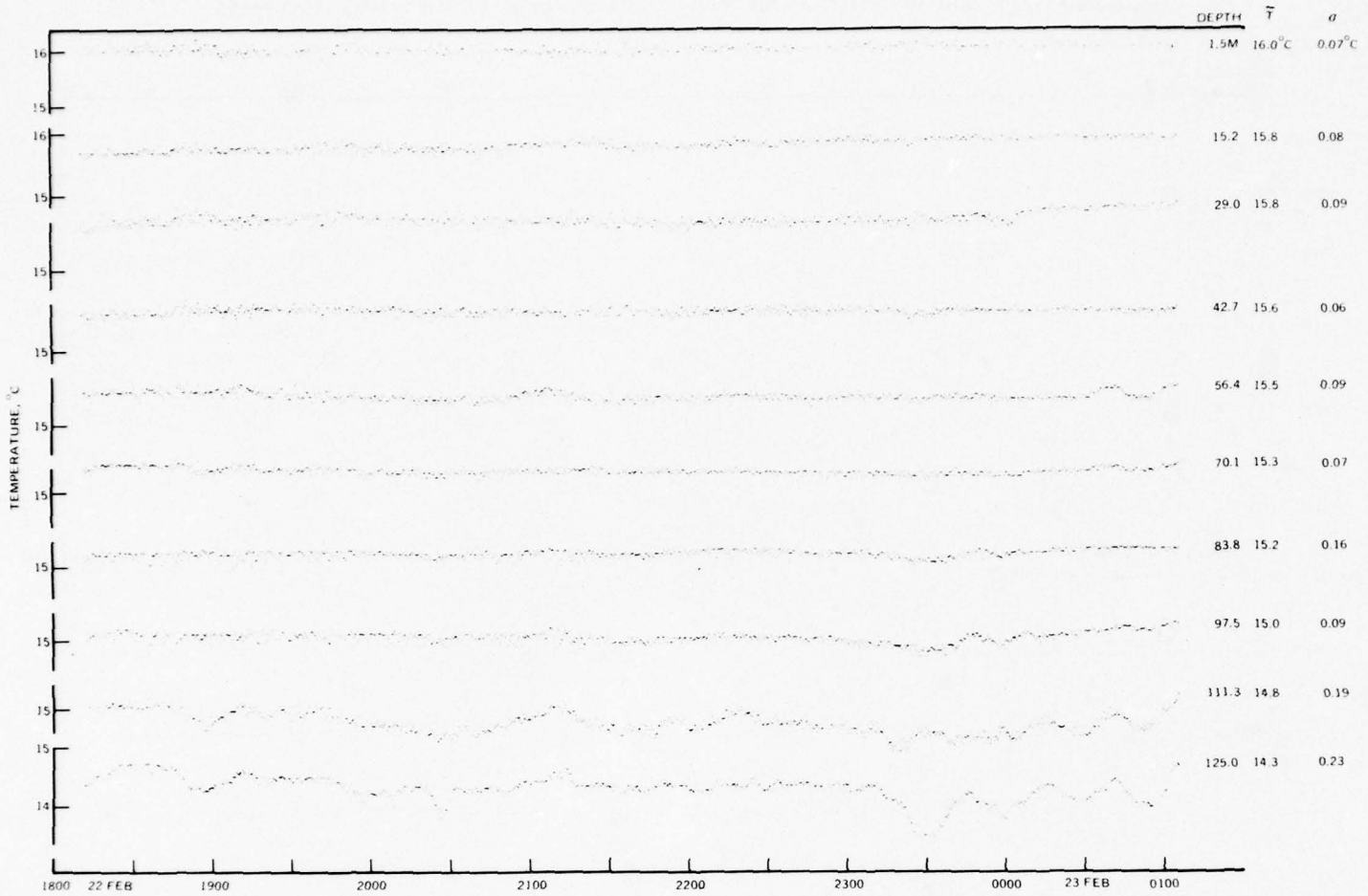

Figure C-7b. Station 4, run 3. Teletherm buoy 6 temperature measurements (n = 2239). Time is LST.

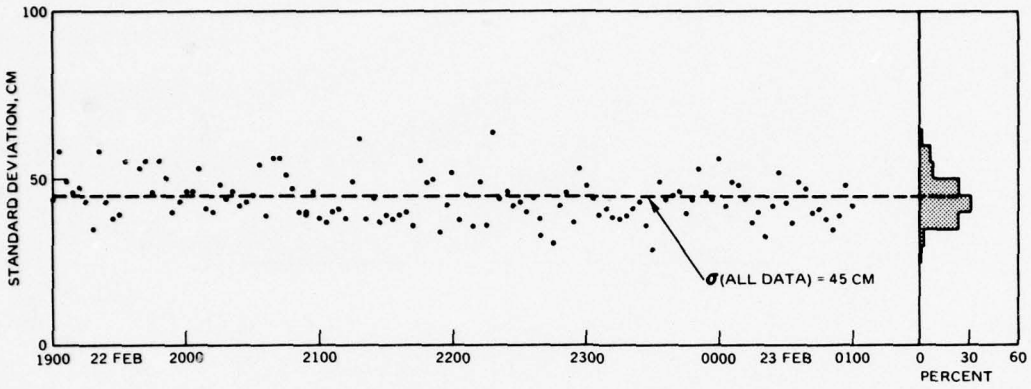

Figure C-8. Station 4, run 3. Standard deviation of surface-wave height for 3-min averages. Time is LST.

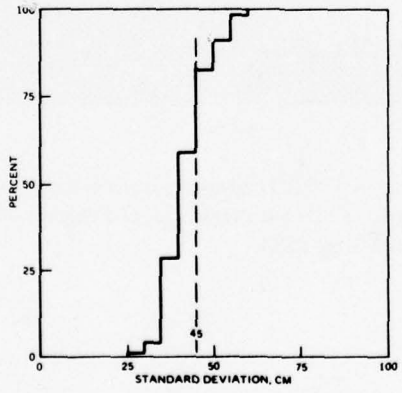

Figure C-9. Station 4, run 3. Ogive of standard deviation of surface-wave height for 3-min averages.

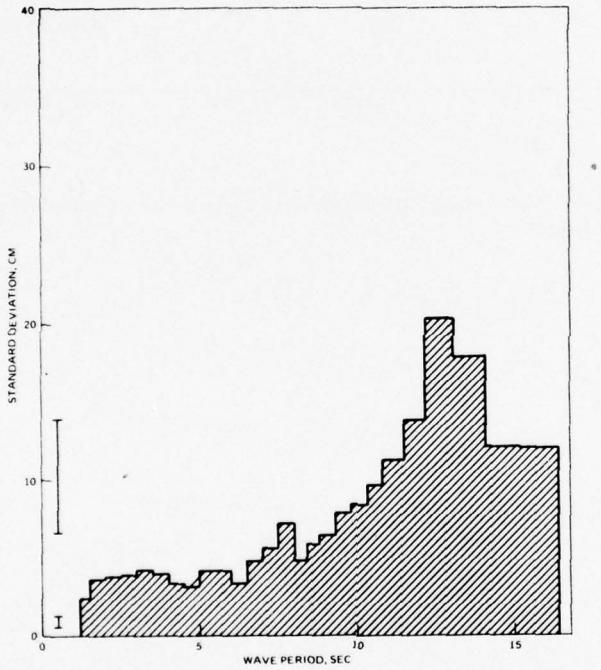

Figure C-10. Station 4, run 3. Standard deviation of wave height as a function of wave period (22-23 February 1972, 1810-0104 LST).

Table C-1. Temperature Profiles (°C),
Station 4 Run 3 (22-23 February 1972 1810-1004 LST).

XBT MEASUREMENTS

Depth, m	261L 1900	262L 2000	263L 2057	264L 2200	265L 2300	267L 0100	140D 2000	141D 2200	101C 2100
0	15.4	15.6	15.8	15.7	15.8	15.7	15.4	15.4	15.7
10	15.4	15.5	15.8	15.6	15.8	15.7	15.5	15.4	15.7
20	15.3	15.5	15.7	15.6	15.7	15.8	15.5	15.4	15.6
30	15.2	15.5	15.4	15.4	15.6	15.7	15.5	15.3	15.4
50	15.2	15.3	15.3	15.3	15.3	15.7	15.5	15.1	15.3
75	14.4	15.1	15.1	15.2	15.2	15.5	15.2	14.9	15.0
100	13.9	14.7	14.8	14.9	14.9	15.5	14.7	14.4	14.8
125	13.2	13.1	14.1	13.9	13.4	13.9	13.3	12.7	13.3
150	12.3	12.0	11.8	11.7	11.9	12.6	12.0	11.6	12.0
200	9.9	10.1	9.9	9.9	9.8	10.0	9.9	9.5	9.9
250	9.0	8.9	8.8	8.9	8.9	9.0	8.8	8.4	8.7
300	8.1	8.1	8.0	8.1	8.0	8.1	8.1	7.8	8.0
400	6.9	6.9	6.8	6.7	6.7	6.8	6.6	6.5	6.8
ILD	10	8	10	8	10	20	67	20	10
T	15.4	15.6	15.8	15.7	15.8	15.7	15.5	15.4	15.7
SLD	52	70	90	95	90	100	67	95	103

THERMISTOR CHAIN MEASUREMENTS

Depth, m	102C 2301	103C 0059	1810	1830	1930	2030	2130	2230	2330	0030
0	15.7	15.7	15.7	15.5	15.5	15.5	15.6	15.6	15.7	15.7
10	15.7	15.7	15.3	15.2	15.4	15.4	15.4	15.4	15.5	15.6
20	15.6	15.7	15.2	15.2	15.4	15.4	15.3	15.3	15.4	15.5
30	15.5	15.6	15.1	15.1	15.3	15.3	15.1	15.2	15.4	15.4
50	15.3	15.3	15.0	14.8	15.1	15.1	15.1	15.1	15.2	15.4
75	15.0	15.0	14.4	14.4	14.8	14.9	15.1	15.0	15.0	15.1
100	14.9	14.8	13.6	13.7	14.2	14.5	14.4	14.6	14.8	14.9
125	14.1	13.5	12.8	12.7	13.9	12.9	13.6	13.5	13.7	13.7
150	12.4	12.3	11.7	12.0	12.1	11.7	11.4	11.9	11.8	12.2
200	10.0	9.9	9.9	10.1	9.8	9.9	9.8	9.8	9.7	9.7
250	8.8	8.8								
300	7.9	7.9								
400	6.7	6.8								
ILD	10	20	0	0	6	6	6	0	6	11
T	15.7	15.7	15.7	15.5	15.5	15.5	15.5	15.6	15.7	15.6
SLD	100	90	39	56	79	85	79	85	85	107

Table C-2. Computed Sound-Speed Profiles (m/sec),
Station 4 Run 3 (22-23 February 1972 1810-0104 LST).

XBT MEASUREMENTS

Depth, m	261L 1900	262L 2000	263L 2057	264L 2200	265L 2300	267L 0100	140D 2000	141D 2200
0	1506.6	1507.2	1507.9	1507.6	1507.9	1507.6	1506.6	1506.6
10	06.8	07.1	08.0	07.4	08.0	07.7	07.1	06.8
20	06.6	07.2	07.9	07.6	07.9	08.2	07.2	06.9
30	06.5	07.4	07.1	07.1	07.7	08.1	07.4	06.8
50	06.8	07.1	07.1	07.1	07.1	08.4	07.8	06.5
75	04.6	06.9	06.9	07.2	07.2	08.2	07.2	06.2
100	03.4	06.1	06.5	06.8	06.8	08.8	06.1	05.1
125	01.6	01.3	04.7	04.0	02.3	04.0	01.9	1499.9
150	1499.0	1497.9	1497.2	1496.9	1497.6	00.0	1497.9	96.5
200	91.6	92.3	91.6	91.6	91.2	1491.9	91.6	90.1
250	89.4	89.0	88.6	89.0	89.0	89.4	88.6	87.1
300	86.9	86.9	86.5	86.9	86.5	86.9	86.9	85.8
400	84.1	84.1	83.7	83.3	83.3	83.7	82.9	82.4
SC	10	8	10	8	10	20	67	20
DC	23	10		10	50	30		
MAX	52	35		20	90	50		
DC				25				
MAX				95				

Depth, m	101C 2100	102C 2301	103C 0059
0	1507.6	1507.6	1507.6
10	07.7	07.7	07.7
20	07.6	07.6	07.9
30	07.1	07.4	07.7
50	07.1	07.1	07.1
75	06.6	06.6	06.6
100	06.5	06.8	06.5
125	01.9	04.7	02.6
150	1497.9	1499.3	1499.0
200	91.6	91.9	91.6
250	88.2	88.6	88.6
300	86.5	86.2	86.2
400	83.7	83.3	83.7
SC	10	10	20
DC		75	
MAX		100	

Table C-2, continued.

THERMISTOR CHAIN MEASUREMENTS

Depth, m	1810	1830	1930	2030	2130	2230	2330	0030
0	1507.5	1506.9	1506.8	1506.8	1507.1	1507.1	1507.5	1507.4
10	06.5	06.2	06.6	06.8	06.7	06.6	07.1	07.5
20	06.3	06.2	06.9	07.0	06.6	06.6	07.0	07.2
30	06.0	06.2	06.8	06.8	06.2	06.4	07.2	07.1
50	06.2	05.6	06.6	06.3	06.3	06.3	06.8	07.3
75	04.7	04.6	06.0	06.3	07.0	06.6	06.6	06.9
100	02.5	02.8	04.5	05.6	05.0	05.9	06.4	06.7
125	00.1	00.0	00.9	00.6	03.0	02.6	03.2	03.3
150	1496.8	1497.9	1498.3	1496.9	1495.8	1497.4	1497.3	1498.7
200	91.6	92.1	91.2	91.5	91.2	91.2	91.0	90.7
SC	0	0	6	6	6	0	6	11
DC	34		10	10	30	50	20	35
MAX	50		20	20	79	85	30	56

Table C-3. Average Sound-Speed Profile (m/sec), Station 4 Run 3 (22-23 February 1972 1810-0104 LST).

Depth, m	Number of Observations	Average Speed	Standard Deviation
0	2493	1507.15	0.26
10	2493	06.89	0.35
20	2493	06.70	0.39
30	2493	06.59	0.42
50	2493	06.51	0.42
75	2493	06.31	0.83
100	2493	05.46	1.42
125	2493	01.97	1.20
150	2493	1497.55	1.01
200	2493	91.31	0.43
250	2493	88.75	0.64
300	16	86.41	0.44
400	16	83.27	0.52
500	9	81.81	0.29
600	5	81.36	0.36
800	4	81.25	0.15
1000	4	82.17	0.22
1200	4	83.47	0.22
1500	4	86.06	0.22
700		1481.20	AXIS

Table C-4. Average Thermistor Chain Temperatures, Station 4 Run 3 (number of measurements at each depth: 2493).

Depth, m	Temperature, °C Min	Max	Mean	Standard Deviation
0	15.35	15.77	15.57	0.079
6	15.17	15.77	15.51	0.123
11	15.15	15.67	15.41	0.111
17	15.07	15.60	15.35	0.109
23	15.02	15.55	15.30	0.125
28	15.00	15.52	15.26	0.136
34	14.97	15.45	15.18	0.134
39	14.97	15.50	15.19	0.126
45	14.90	15.45	15.15	0.124
51	14.72	15.42	15.10	0.135
56	14.67	15.42	15.08	0.146
62	14.57	15.42	15.04	0.156
68	14.32	15.35	14.99	0.203
73	14.12	15.17	14.93	0.245
79	14.07	15.20	14.89	0.291
85	13.82	15.15	14.82	0.329
90	13.72	15.10	14.72	0.362
96	13.67	15.07	14.64	0.384
101	13.37	15.10	14.43	0.423
107	13.07	15.05	15.22	0.437
113	12.92	14.70	14.00	0.422
118	12.62	14.40	13.70	0.396
124	12.57	14.02	13.37	0.357
130	12.37	13.70	13.04	0.280
135	11.95	13.52	12.73	0.284
141	11.72	13.17	12.42	0.299
147	11.37	12.92	12.11	0.322
152	11.17	12.47	11.74	0.293
158	10.95	12.15	11.44	0.291
164	10.67	11.87	11.13	0.254
169	10.42	11.47	10.84	0.209
175	10.27	11.12	10.61	0.166
180	10.07	10.90	10.41	0.138
186	9.97	10.70	10.21	0.128
192	9.75	10.55	10.06	0.135
197	9.65	10.37	9.89	0.121
203	9.45	10.22	9.76	0.121
209	9.25	9.87	9.60	0.117
214	9.12	9.80	9.43	0.134
220	8.97	9.62	9.30	0.118
226	8.95	9.55	9.18	0.114
231	8.82	9.40	9.06	0.123
237	8.62	9.37	9.01	0.147
242	8.57	9.30	8.94	0.168

Table C-5. Standard Deviation (cm) of Wave Height for 3-Min Averages, Station 4 Run 3 (22-23 February 1972 1810-0104 LST).

	Hours						
Minutes	1900	2000	2100	2200	2300	0000	0100
00	44	46	38	52	48	56	42
03	58	46	37	38	44	52	
06	49	53	40	45	39	49	
09	46	41	41	36	41	48	
12	47	40	38	49	39	47	
15	43	48	49	36	38	37	
18	35	44	62	64	39	40	
21	58	46	38	44	41	33	
24	43	42	44	46	43	42	
27	38	43	37	42	36	52	
30	39	45	39	43	29	43	
33	55	54	38	40	49	37	
36	45	39	39	44	44	49	
39	53	56	40	33	45	47	
42	55	56	36	38	46	40	
45	46	51	55	31	40	41	
48	55	47	49	42	44	38	
51	50	40	50	46	53	35	
54	40	39	34	37	46	39	
57	43	46	42	53	44	48	

Table C-6. Standard Deviation of Wave Height as a Function of Wave Period, Station 4 Run 3 (22-23 February 1972 1810-0104 LST).

Wave-Period Band, sec	Standard Deviation, cm	Wave-Period Band, sec	Standard Deviation, cm
1.2 – 1.4	2.5	7.5 – 7.9	7.2
1.5 – 1.9	3.7	8.0 – 8.3	4.8
2.0 – 2.4	3.8	8.4 – 8.7	5.8
2.5 – 2.9	3.9	8.8 – 9.2	6.4
3.0 – 3.4	4.3	9.3 – 9.7	7.8
3.5 – 3.9	4.0	9.8 – 10.2	8.3
4.0 – 4.4	3.4	10.3 – 10.7	9.6
4.5 – 4.9	3.2	10.8 – 11.4	11.2
5.0 – 5.4	4.2	11.5 – 12.1	13.7
5.5 – 5.9	4.2	12.2 – 13.0	20.1
6.0 – 6.4	3.4	13.1 – 14.0	17.7
6.5 – 6.9	4.8	14.1 – 15.1	12.0
7.0 – 7.4	5.6	15.2 – 16.4	11.9

APPENDIX D

STATION 4 RUN 4

DETAILED ENVIRONMENTAL DATA SUMMARY

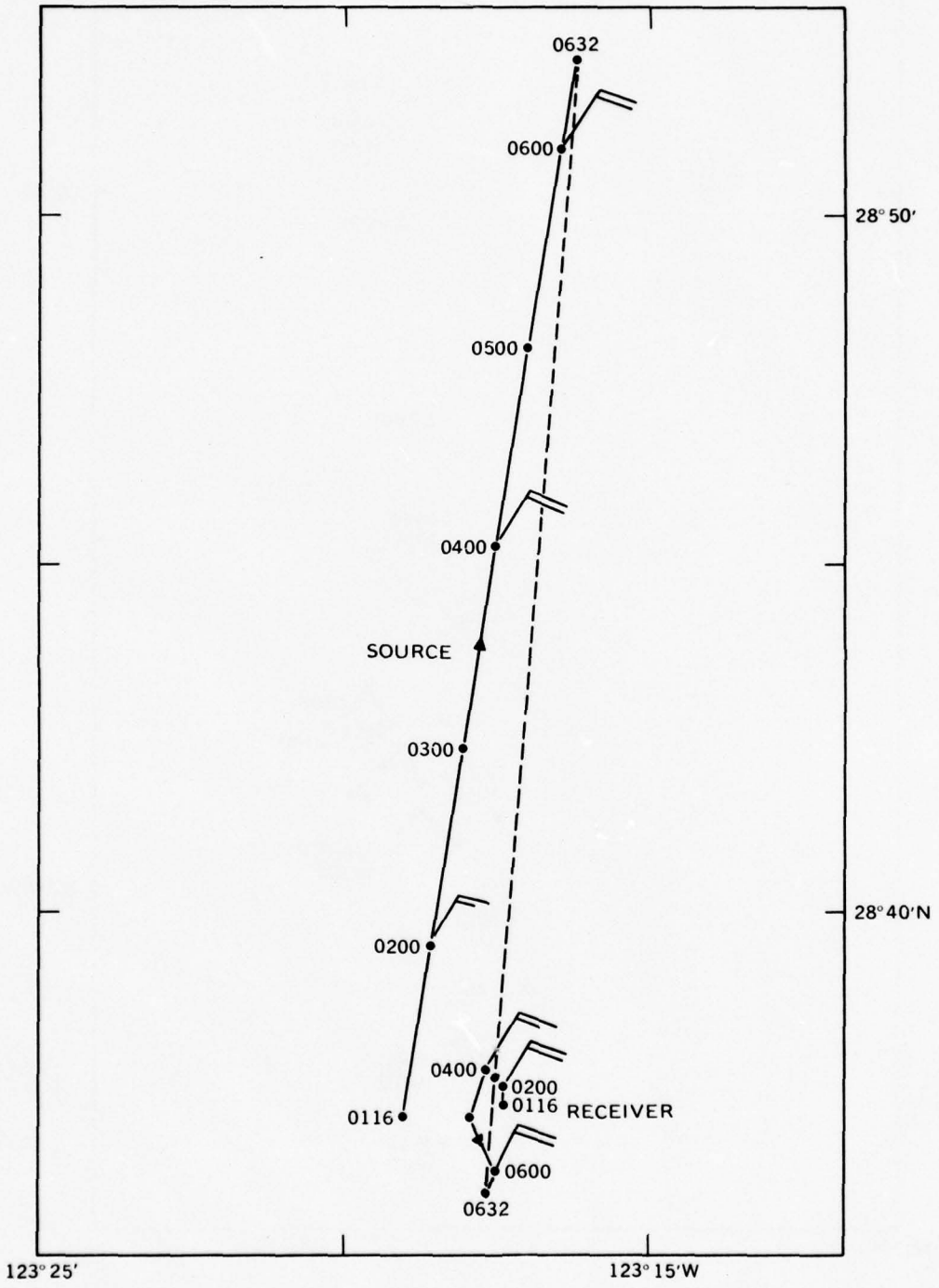

Figure D-1. Station 4, run 4. Location of source and receiver ships, 0632 LST propagation path (---), and wind velocity (10-knot east wind, 1 bar = 5 knots).

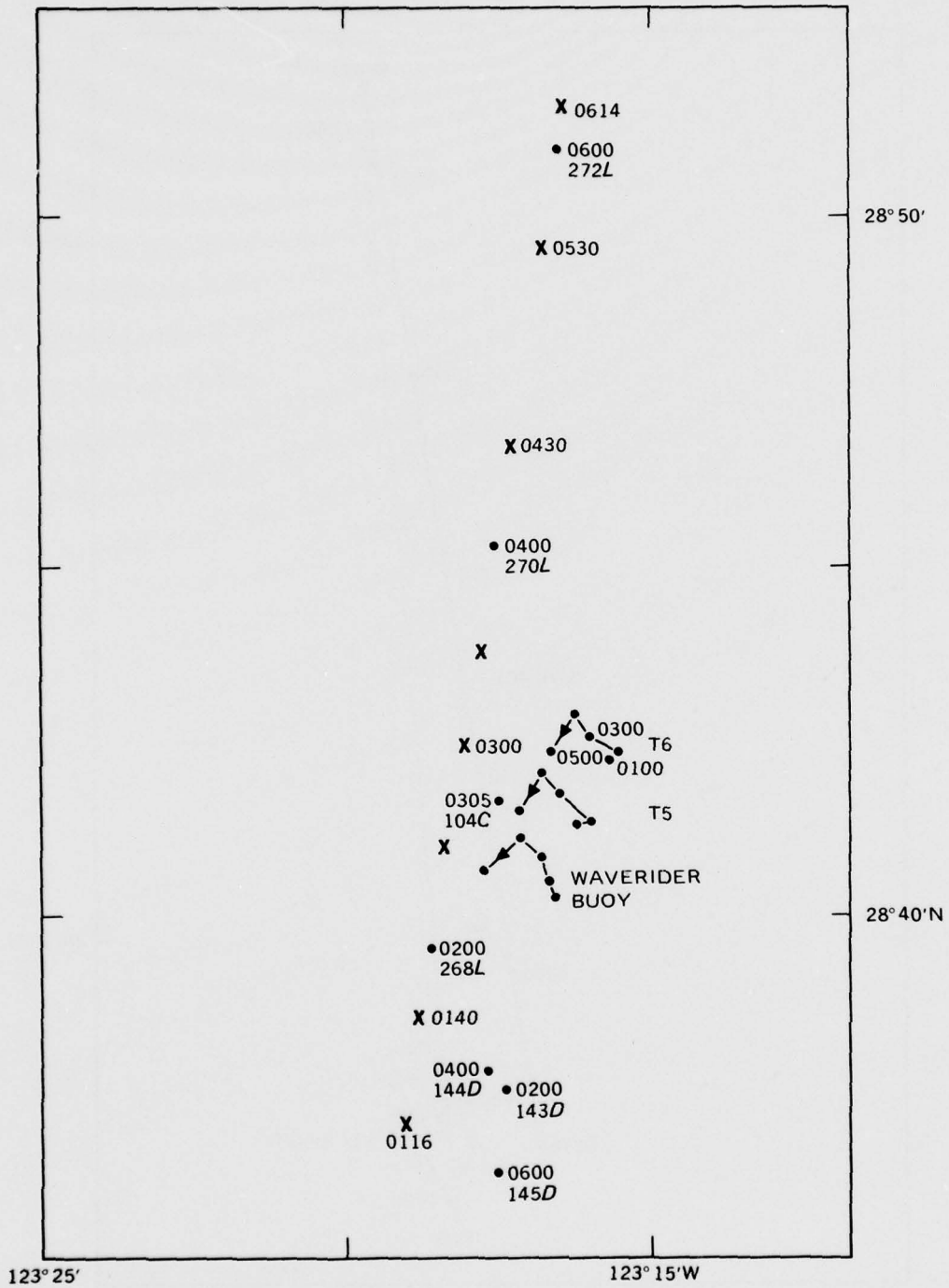

Figure D-2. Station 4, run 4. Location of XBT (·), thermistor chain (X), Teletherm buoy (T), and Waverider buoy measurements. Letter following XBT number denotes the ship which took the measurement (*L:Lee, D:DeSteiguer, C:Cape*). Times shown are LST.

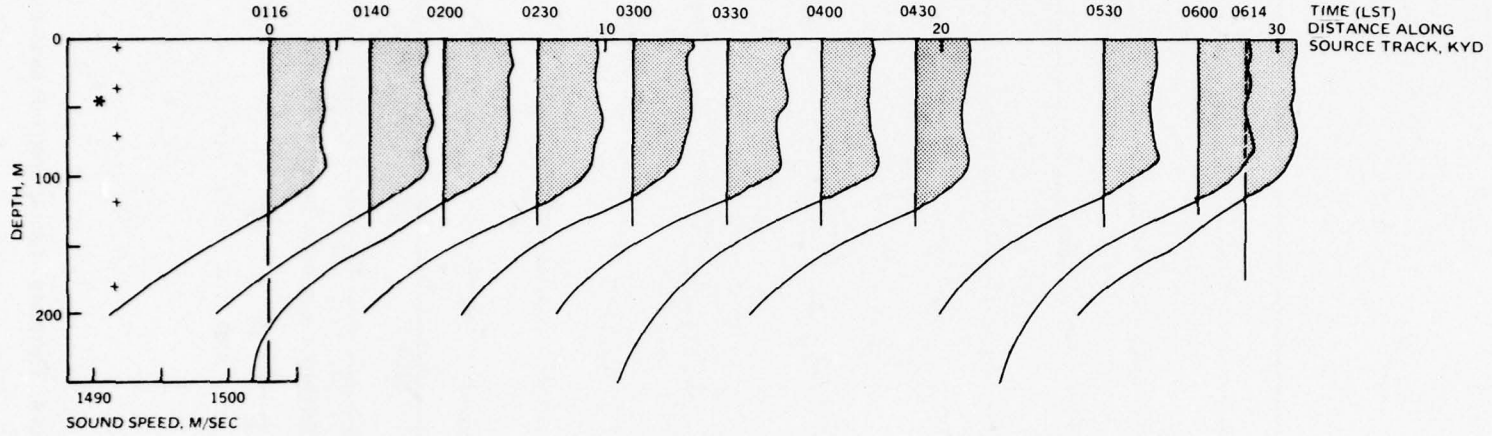

Figure D-3. Station 4, run 4. Sound-speed profiles along track of source ship derived from XBT and thermistor chain data. Source depth (*), receiver depth (+).

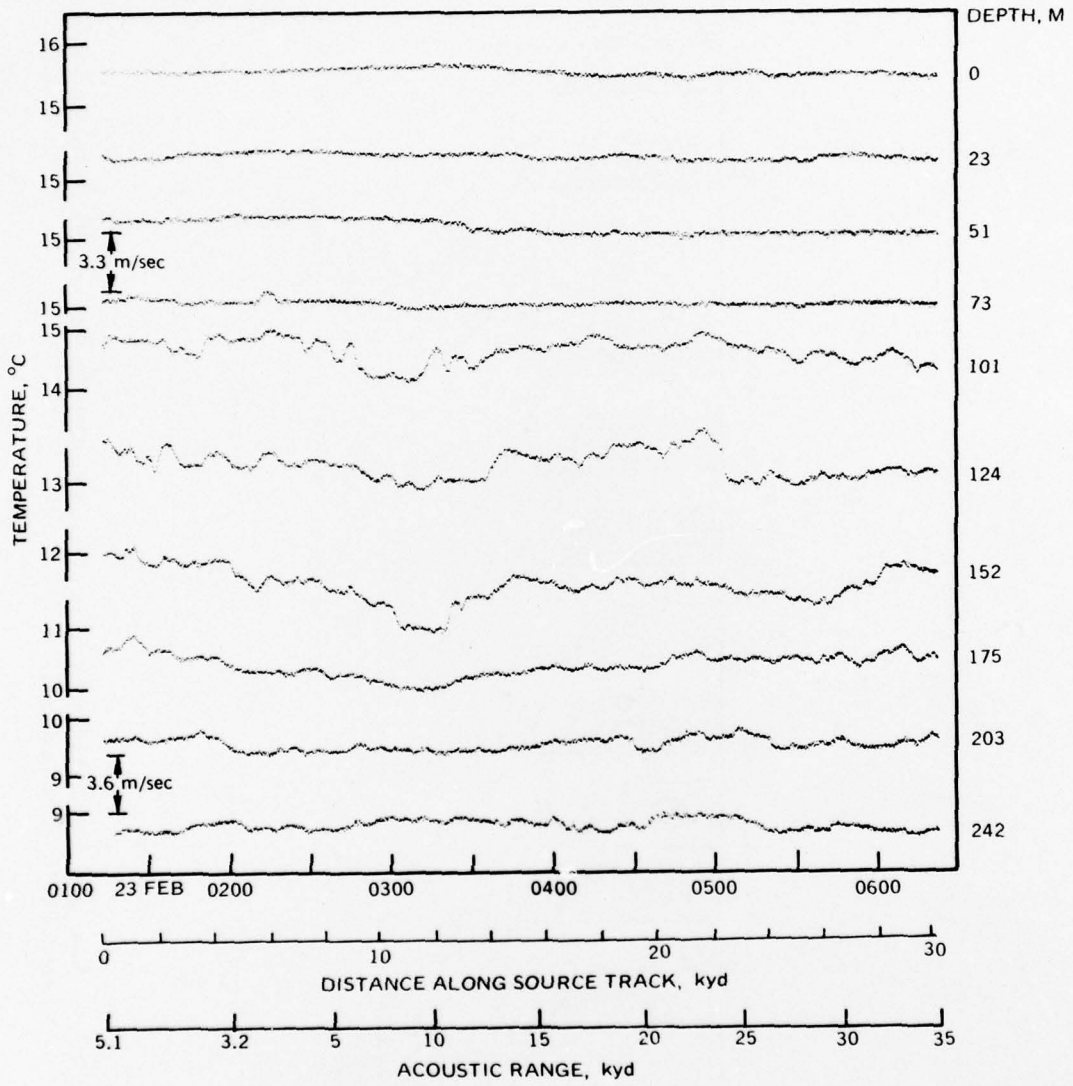

Figure D-4. Station 4, run 4. Thermistor chain temperature measurements at selected depths. Time is LST.

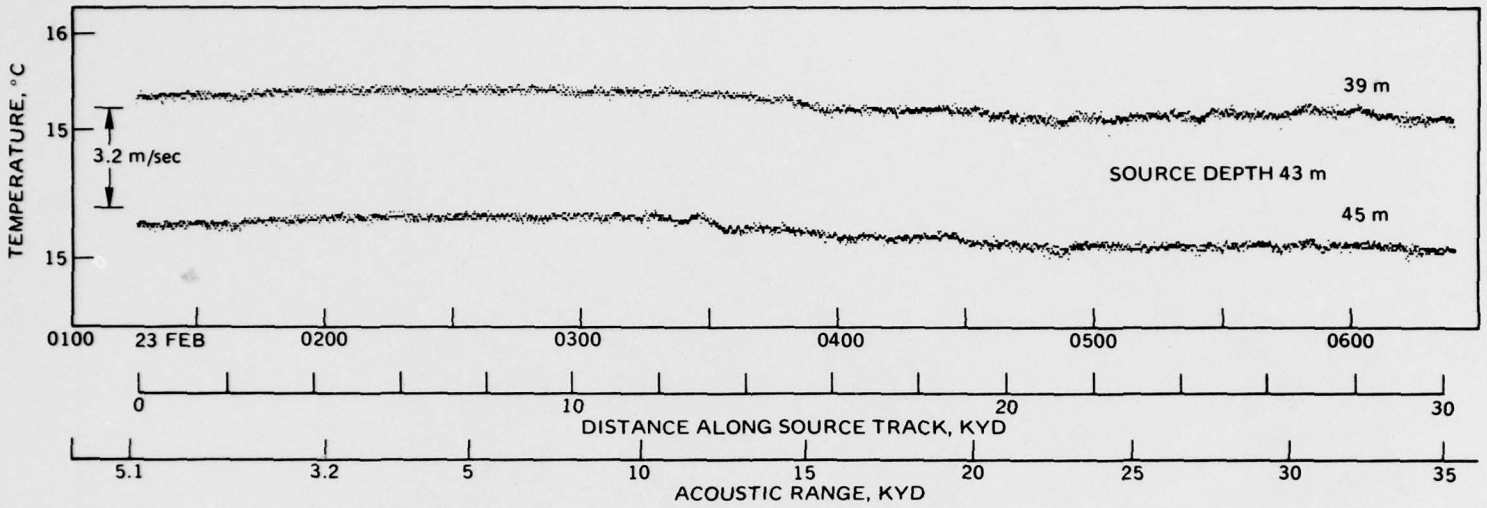

Figure D-5. Station 4, run 4. Temperatures above and below source. Time is LST.

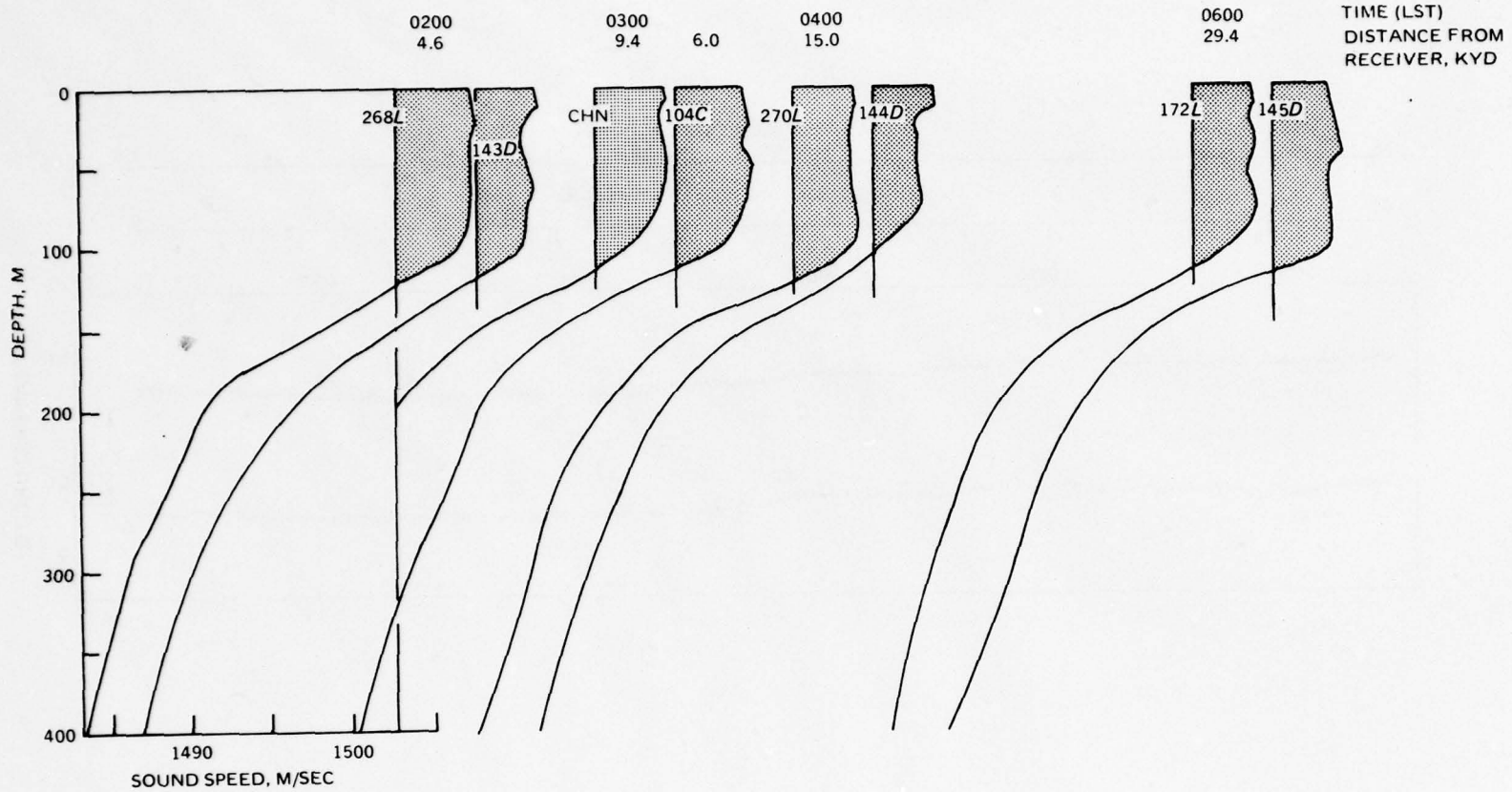

Figure D-6. Station 4, run 4. Spatial change in sound-speed profiles.

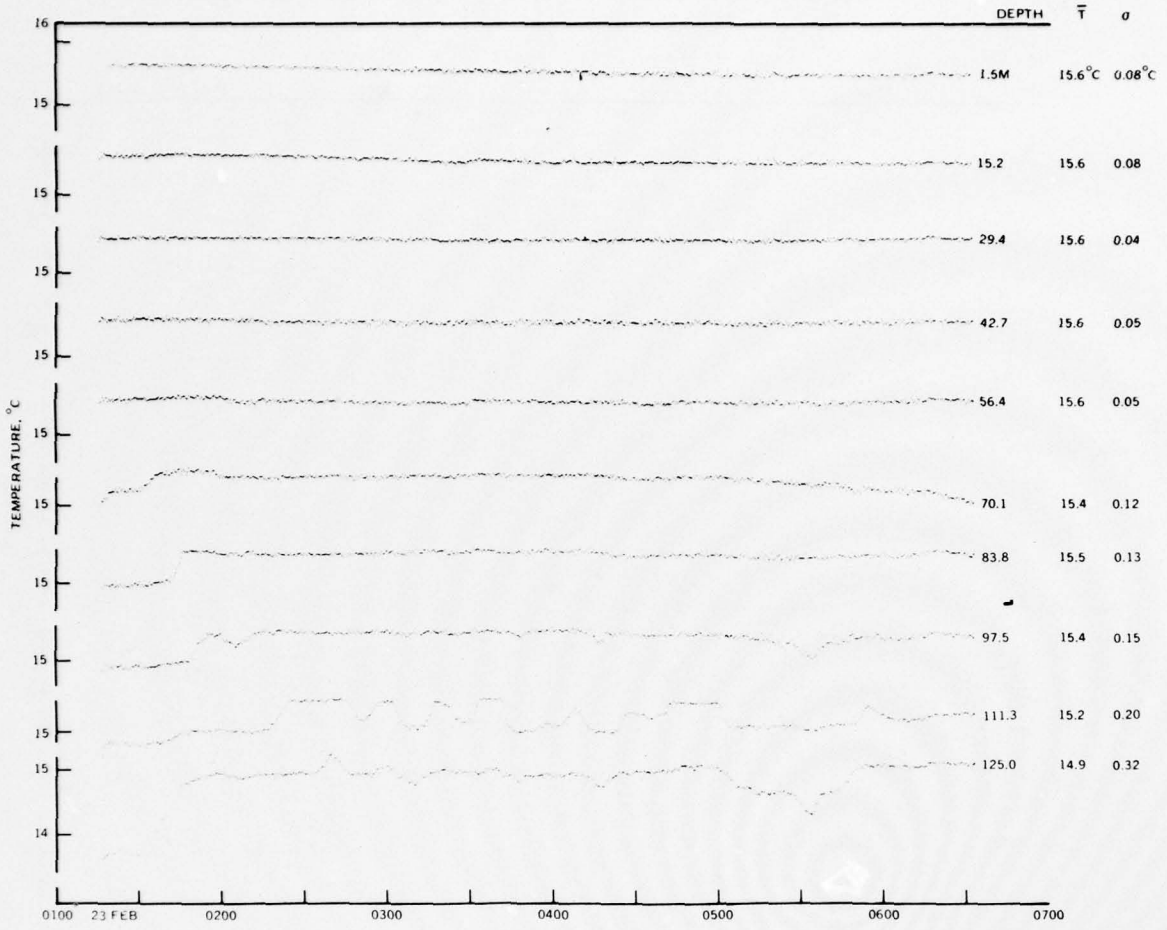

Figure D-7a. Station 4, run 4. Teletherm buoy 5 temperature measurements (n = 1828). Time is LST.

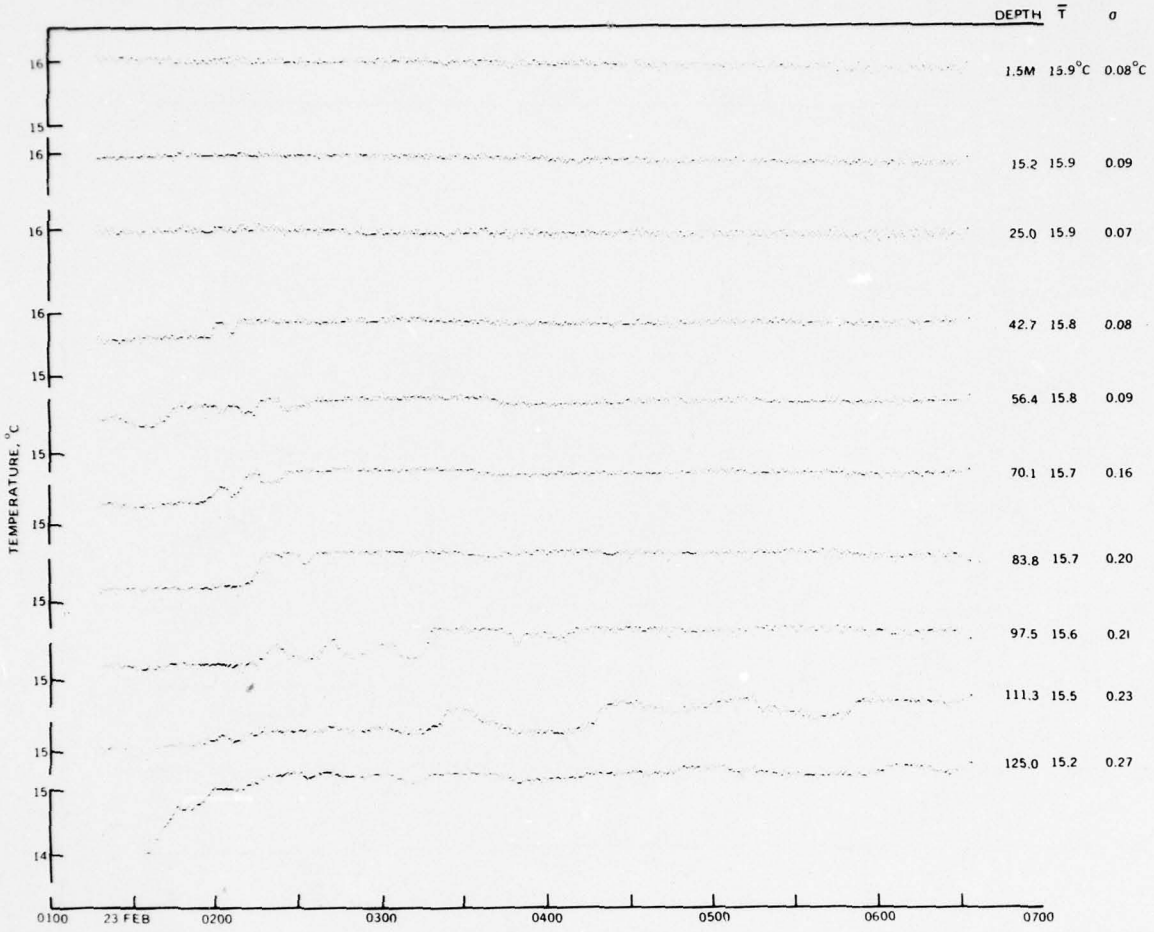

Figure D-7b. Station 4, run 4. Teletherm buoy 6 temperature measurements (n = 1620). Time is LST.

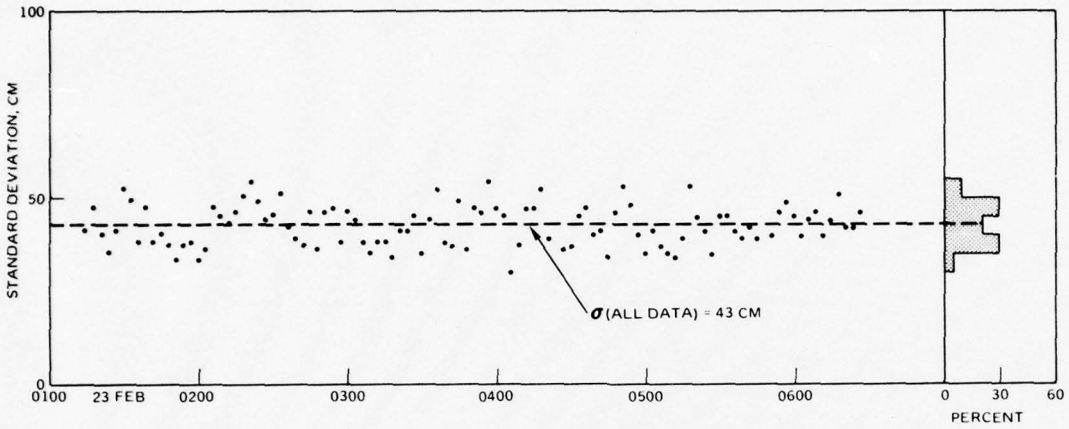

Figure D-8. Station 4, run 4. Standard deviation of surface-wave heights for 3-min averages.

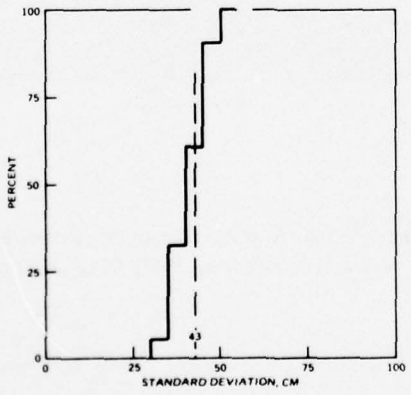

Figure D-9. Station 4, run 4. Ogive of standard deviation of surface-wave height for 3-min averages.

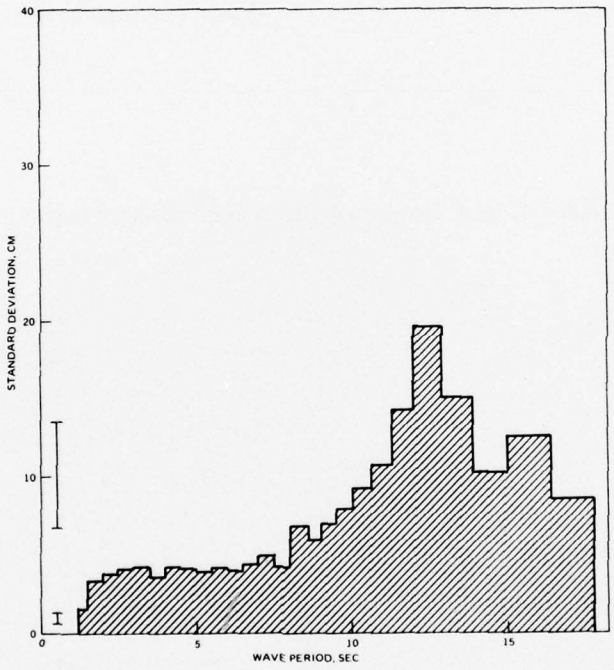

Figure D-10a. Station 4, run 4. Standard deviation of wave height as a function of wave period. (23 February 1972, 0116-0527 LST).

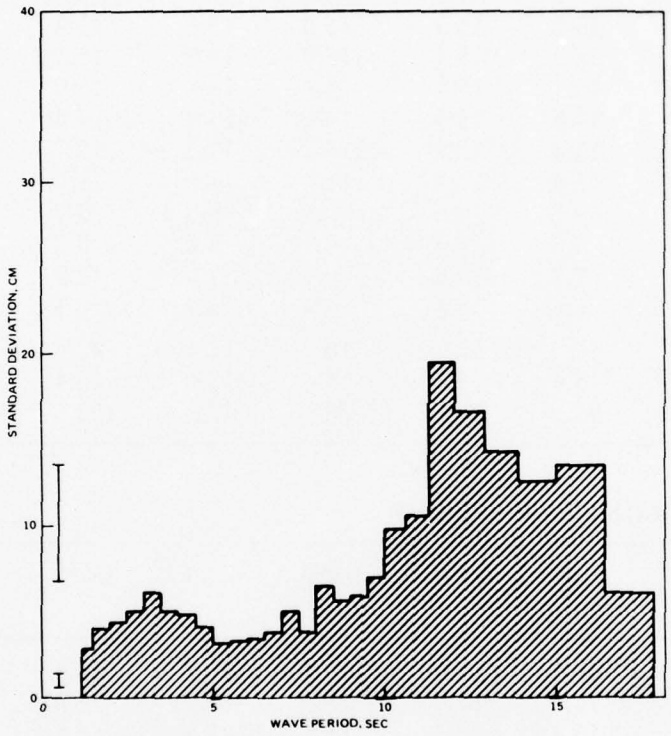

Figure D-10b. Station 4, run 4. Standard deviation of wave height as a function of wave period (23 February 1972, 0528-0630 LST).

Table D-1. Temperature Profiles (°C),
Station 4 Run 4 (23 February 1972 0116-0652 LST).

XBT MEASUREMENTS

Depth, m	268L 0200	270L 0402	272L 0600	143D 0200	144D 0400	145D 0600	104C 0305
0	15.7	15.4	15.4	15.4	15.4	15.3	15.6
10	15.7	15.4	15.4	15.4	15.4	15.4	15.6
20	15.7	15.3	15.3	15.1	15.0	15.4	15.6
30	15.6	15.2	15.3	15.0	15.0	15.4	15.5
50	15.5	15.1	15.1	15.0	14.9	15.1	15.5
75	15.3	15.1	15.1	14.9	14.8	15.0	15.2
100	14.8	14.8	14.5	14.5	13.9	14.8	14.6
125	13.3	13.1	13.1	13.2	12.7	12.7	12.8
150	12.0	11.4	11.4	11.9	11.2	11.2	11.4
200	9.7	9.7	9.6	9.8	9.3	9.7	9.6
250	8.8	8.6	8.7	8.5	8.4	8.7	8.8
300	7.9	7.9	7.9	7.6	7.6	8.0	7.9
400	6.7	6.6	6.8	6.4	6.3	6.5	6.6
ILD	20	10	10	10	12	42	20
T	15.4	15.4	15.4	15.4	15.4	15.4	15.6
SLD	94	92	78	88	72	102	96

THERMISTOR CHAIN MEASUREMENT

Depth, m	0116	0140	0230	0300	0330	0430	0530	0614
0	15.6	15.5	15.6	15.6	15.7	15.5	15.4	15.4
10	15.6	15.5	15.6	15.5	15.5	15.5	15.4	15.4
20	15.5	15.4	15.5	15.4	15.4	15.4	15.4	15.3
30	15.4	15.4	15.4	15.4	15.5	15.3	15.3	15.2
50	15.3	15.4	15.4	15.4	15.3	15.1	15.1	15.0
75	15.1	15.2	15.2	15.1	15.1	15.0	15.1	15.0
100	14.9	14.8	14.8	14.4	14.6	14.7	14.5	14.5
125	13.7	13.6	13.3	13.1	13.1	13.5	12.9	13.1
150	12.2	12.1	11.7	11.4	11.4	11.8	11.4	12.0
200	9.8	9.9	9.5	9.6	9.5	9.7	9.7	9.7
ILD	11	11	11	6	6	11	17	11
T	15.6	15.5	15.6	15.6	15.7	15.5	15.4	15.4
SLD	96	96	96	90	96	85	85	73

Table D-2. Computed Sound-Speed Profiles (m/sec), Station 4 Run 4 (23 February 1972 0116-0632 LST).

XBT MEASUREMENTS

Depth, m	268L 0200	270L 0402	272L 0600	143D 0200	144D 0400	145D 0600	104C 0305
0	1507.2	1506.6	1506.6	1506.6	1506.6	1506.3	1507.2
10	07.7	06.8	06.8	06.8	06.8	06.8	07.4
20	07.9	06.6	06.6	06.0	05.6	06.9	07.6
30	07.7	06.5	06.8	05.8	05.8	07.1	07.4
50	07.8	06.5	06.5	06.2	05.8	06.5	07.8
75	07.6	06.9	06.9	06.2	05.9	06.6	07.2
100	06.5	06.5	05.5	05.5	03.4	06.5	05.8
125	01.9	01.3	01.3	01.6	1499.9	1499.9	00.2
150	1497.9	1495.8	1495.8	1497.6	95.1	95.7	1495.8
200	90.8	90.8	90.5	91.2	89.4	90.8	90.5
250	88.6	87.8	88.2	87.5	87.1	88.2	88.6
300	86.2	86.2	86.2	85.0	85.0	86.5	86.2
400	83.3	82.9	83.7	82.9	81.6	82.4	82.9
SC	20	10	10	10	12	42	20
DC	30	50	20	30	20	50	40
MAX	50	85	30	65	72	75	50
DC			50				
MAX			78				

THERMISTOR CHAIN MEASUREMENTS

Depth, m	0116	0140	0230	0300	0330	0430	0530	0614
0	1507.2	1507.0	1507.2	1507.3	0507.4	1506.8	1506.7	1506.6
10	07.3	07.1	07.3	07.1	07.2	07.0	06.8	06.7
20	07.1	07.0	07.2	07.0	07.1	06.9	06.8	06.5
30	06.9	06.9	07.2	07.2	07.3	06.8	06.7	06.5
50	07.1	07.3	07.5	07.3	07.0	06.4	06.4	06.3
75	06.9	07.1	07.1	06.8	06.8	06.7	06.7	06.6
100	06.7	06.6	06.4	05.0	05.8	06.1	05.4	05.4
125	03.2	02.9	01.9	01.2	01.1	02.7	00.7	01.2
150	1498.6	1498.4	1597.0	1495.7	1496.0	1497.3	1495.7	1498.0
200	91.2	91.4	90.2	90.5	90.1	90.8	90.7	90.7
SC	11	11	11	6	6	11	17	11
DC	34	34	34	11	11	50	50	50
MAX	56	62	62	28	45	85	85	73
DC	73	68			62			
MAX	96	96			96			

Table D-3. Average Sound-Speed Profile (m/sec), Station 4 Run 4 (23 February 1972 0116-0632 LST).

Depth, m	Number of *Observations*	Average *Speed*	Standard Deviation
0	1854	1507.05	0.22
10	1854	07.08	0.22
20	1854	06.99	0.23
30	1854	06.94	0.26
50	1854	06.80	0.46
75	1854	06.81	0.20
100	1854	06.20	0.64
125	1854	01.87	0.79
150	1854	1496.89	1.09
200	1854	90.71	0.36
250	1854	88.07	0.34
300	12	85.94	0.50
400	12	82.77	0.58
500	9	81.81	0.29
600	5	81.36	0.36
800	4	81.25	0.15
1000	4	82.17	0.22
1200	4	83.47	0.22
1500	4	86.06	0.22
10		1507.08	SC
700		1481.20	AXIS

Table D-4. Average Thermistor Chain Temperatures, Station 4 Run 4 (number of measurements at each depth: 1584).

Depth, m	Temperature °C			Standard Deviation
	Min	Max	Mean	
0	15.32	15.70	15.54	0.069
6	15.35	15.70	15.53	0.067
11	15.32	15.65	15.48	0.066
17	15.27	15.65	15.43	0.067
23	15.22	15.55	15.40	0.067
28	15.17	15.52	15.37	0.078
34	15.10	15.47	15.30	0.084
39	14.97	15.47	15.29	0.111
45	14.97	15.45	15.25	0.126
51	14.95	15.45	15.18	0.136
56	14.95	15.42	15.17	0.132
62	14.97	15.40	15.15	0.117
68	14.97	15.35	15.10	0.092
73	14.95	15.30	15.08	0.059
79	14.92	15.20	15.07	0.050
85	14.70	15.15	15.02	0.072
90	14.62	15.15	14.95	0.095
96	14.57	15.15	14.88	0.122
101	14.12	15.02	14.64	0.196
107	13.80	14.87	14.34	0.239
113	13.40	14.70	14.08	0.284
118	13.22	14.30	13.71	0.253
124	12.90	13.90	13.32	0.225
130	12.52	13.47	13.02	0.159
135	11.97	13.07	12.68	0.254
141	11.50	13.00	12.32	0.351
147	10.97	12.60	11.90	0.335
152	10.72	12.15	11.50	0.287
158	10.50	11.95	11.17	0.327
164	10.25	11.60	10.89	0.272
169	10.07	11.15	10.64	0.228
175	10.00	10.95	10.43	0.180
180	9.87	10.67	10.26	0.144
186	9.70	10.45	10.06	0.148
192	9.55	10.22	9.89	0.120
197	9.47	10.05	9.74	0.114
203	9.37	9.85	9.58	0.098
209	9.22	9.65	9.44	0.077
214	9.07	9.50	9.31	0.071
220	9.02	9.40	9.20	0.065
226	8.90	9.30	9.09	0.063
231	8.82	9.10	8.98	0.051
237	8.62	9.05	8.91	0.078
242	8.57	9.00	8.79	0.090

Table D-5. Standard Deviation (cm) of Wave Height for 3-Min Averages, Station 4 Run 4 (23 February 1972 0116-0632 LST).

	Hours					
Minutes	0100	0200	0300	0400	0500	0600
01		33	46	47	35	45
04		36	44	45	41	40
07		47	38	30	37	44
10		45	35	37	35	46
13		43	38	47	34	40
16	41	46	38	47	39	44
19	47	50	34	52	53	51
22	40	54	41	39	45	42
25	35	49	41	43	41	42
28	41	44	45	36	35	46
31	52	45	35	37	45	
34	49	51	44	45	45	
37	38	42	52	47	41	
40	47	39	38	40	39	
43	38	37	37	41	42	
46	40	46	49	34	39	
49	37	36	36	46	43	
52	33	46	47	43	40	
55	37	47	46	48	46	
58	38	38	54	40	49	

Table D-6. Standard Deviation of Wave Height as a Function of Wave Period, Station 4 Run 2 (23 February 1972).

Wave-Period Band, sec	Standard Deviation, cm	Wave-Period Band, sec	Standard Deviation, cm
0116-0527 LST			
1.2 – 1.4	1.6	7.5 – 7.9	4.3
1.5 – 1.9	3.4	8.0 – 8.5	6.9
2.0 – 2.4	3.9	8.6 – 8.9	6.0
2.5 – 2.9	4.2	9.0 – 9.4	7.0
3.0 – 3.4	4.3	9.5 – 9.9	8.0
3.5 – 3.9	3.7	10.0 – 10.5	9.3
4.0 – 4.4	4.3	10.6 – 11.2	10.8
4.5 – 4.9	4.2	11.3 – 11.9	14.3
5.0 – 5.4	4.0	12.0 – 12.8	19.6
5.5 – 5.9	4.2	12.9 – 13.8	15.1
6.0 – 6.4	4.0	13.9 – 14.9	10.3
6.5 – 6.9	4.5	15.0 – 16.3	12.6
7.0 – 7.4	5.0	16.4 – 17.8	8.6
0528-6030 LST			
1.2 – 1.4	2.8	7.5 – 7.9	3.8
1.5 – 1.9	4.0	8.0 – 8.5	6.5
2.0 – 2.4	4.4	8.6 – 8.9	5.6
2.5 – 2.9	5.0	9.0 – 9.4	5.9
3.0 – 3.4	6.1	9.5 – 9.9	7.0
3.5 – 3.9	5.0	10.0 – 10.5	9.8
4.0 – 4.4	4.9	10.6 – 11.2	10.6
4.5 – 4.9	4.1	11.3 – 11.9	19.5
5.0 – 5.4	3.2	12.0 – 12.8	16.6
5.5 – 5.9	3.3	12.9 – 13.8	14.3
6.0 – 6.4	3.4	13.9 – 14.9	12.6
6.5 – 6.9	3.8	15.0 – 16.3	13.5
7.0 – 7.4	5.0	16.4 – 17.8	6.1